
# XR4CRAFTS

2022-1-DE02-KA220-VET-000087844

## Didactic Guidelines

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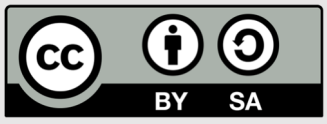

# Content

# WHY: Introduction

The use of digital technologies in VET transitions every day more from an add-on to a must-have. It is inevitable to find current and prospective fields of application especially for craftsmanship training. Central is pedagogic sound application.

A digital technology with educational potential is Extended Reality (XR). It is an umbrella term for technologies like Augmented Reality (AR), Virtual Reality (VR), and VR haptics. Experiences concerning methodological and pedagogic value in practical training in craftsmanship is rare. These guidelines aim to change it by providing first-hand insights on the selection, testing, and evaluation of suitable scenarios for four craftsmanship professions: bricklayer, carpenter, parquet layer, and painter.

The guiding question of these didactic guidelines is:

**Where the use of XR as an educational technology does make sense pedagogically, to support the provision of professional skills, increase collaboration, and provide media skills among trainers and apprentices?**

These guidelines will help VET personnel to understand, select, apply, and evaluate Extended Reality technologies and practices in practical VET training for the four craftsmanship professions and beyond.

# WHAT: Hard- and Software

The XR4CRAFTS project applied the following educational technologies:

**Virtual Reality (VR)** is the immersion in a completely digital world with standalone VR headset glasses (e.g. Meta Quest 3 – around 500 €). The real world is not visible. Preferably complex, expensive and dangerous processes can be simulated.

**Virtual Reality haptics** refer to the use of special so-called gloves, which allow a sense of feel and touch by generate haptic feedback by vibrations on the fingertips (e.g. Tactgloves by bHaptics) or additionally in the entire palm of your hand (e.g. Senseglove). These gloves are used in VR environments to stimulate muscle memory. Vibrations represent a low-cost technology, which is easy to use and fosters the facilitation of various interactions like vibrations, clicks and active objects. A continuous use is not recommended. In contrast to more pricy haptic gloves like Senseglove, where a use suits better for slow and continuous types of interactions.

**Augmented Reality (AR)** is the computer-aided extension of reality by overlaying it with digital information. This can be done using relevant headsets (e.g. Microsoft HoloLens 2) or by smartphones or tablets. With AR, training processes can be supported by no-code solution for self-directed learning like “Microsoft Guides” or through interactive 3D holograms (“digital twins”). The use of smart glasses allows that both hands are free during live training, when interacting with the glasses.

These technologies *extend* reality by adding or simulating reality through digital inputs and are an effective way to update training programs. By integration XR into your training, you could immerse your learners in a multisensory environment which is more interactive, engaging, and effective at the long-term.

XR4CRAFTS focussed on tailor-made, programmed VR and VR haptic scenarios by using Meta Quest 3 glasses and Bhaptic Tactgloves, as well as no-code AR scenarios with Microsoft guides. This ensured to make an **XR training site** a reality.

Meta Quest 3

Tactgloves

Microsoft HoloLens 2

# HOW: Pedagogic models

The application of the XR4CRAFTS as educational technologies must pedagogic-sound.

Existing learning theories provide frameworks and models to develop suitable approaches for technology enriched practical training.

To successfully implement a new technology within practical training a four-step approach is recommended.

**Step 1: What effect the technology is expected to have.**

The use of the SAMR model helps to classify the potential impact. SAMR stands for:

- Substitution (technology substitution, task the same),
- Augmentation (technology substitution, task enhancement),
- Modification (task redesign), and
- Redefinition (creation of new tasks).

The use Extended Reality (XR) is expected to rather **augment** existing working tasks by using these technologies to enrich the provision of professional and media skills further.

**Step 2: Decision on sound combination of work knowledge, appropriate learning approaches technology and content.**

The trainer and the apprentice require knowledge of following areas:

• Working Knowledge– What practical competences are necessary to master a task and how Extended Reality (AR, VR, VR haptics) support learning?
• Content Knowledge - What lesson content does he or she want to offer with XR?
• Andragogy Knowledge or Adult learning approaches – What are appropriate ways to support and facilitate teaching and learning when XR?
• Technology Knowledge- How should AR, VR, and VR haptics as educational technologies used to achieve the learning goals?

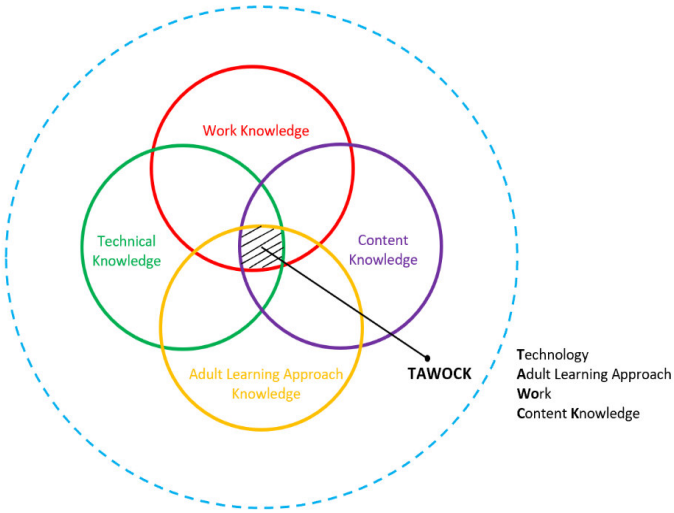


*Figure 1. TAWOCK model elements*

**"TAWOCK"** provides a framework for planning (lesson plan) and subsequent execution of practical trainings. It results in a technology-enriched and pedagogical effective provision of learning contents.

**STEP 3: Decision on what are the learning objectives.**

The integration of AR, VR, and VR haptics in a specific lesson demands a careful description of the desired outcomes. This can reach from the provision of e. g. procedural knowledge to the enrichment of communication and collaboration as a teaching method. The focus in practical training is according to Bloom:

For:

a) Augmented Reality: rather on activities such as "**clarify**", "**carry out**", "**integrate**" or "**judge**".
b) Virtual Reality and Virtual Reality haptics rather on activities such as "**recognize**", "**recall**", "**summarize**" or "**classify**".

After the definition of the expected impact (augmentation), the integration of the relevant knowledge (TAWOCK) and the clarification of the learning objectives the lesson plan can be created. To assess the impact an evaluation must take place.

**STEP 4: Evaluation of the scenario**

The scenario-based integration of technologies is evaluated by formative assessments (questionnaires: trainer and self-assessment by learners). The forms are accessible in Appendix 2.

**The four-step approach determines the XR4CRAFTS qualification model.**

# Survey based training needs to create the XR4CRAFTS apps

To assess existing and future training demands an structured online questionnaire (**see Annex 1**) and expert interviews (**see Annex 2**) were carried out in 2023 among teachers and trainers from the fields of bricklaying, carpentry, parquet laying and painting. Focus countries were Belgium, France, Germany, and Spain. In sum 80 field professionals have been interviewed, 9 of them during expert interviews.

Following XR or Extended Reality describes the educational technologies AR, VR, and VR haptics.

Only 5% or 4 persons out of the 71 respondents have experience with XR. The majority expected that XR is a suitable technology for preparing learners **upfront** of practical training e. g. in the classroom. Less than half see also potential during practical training and only around 20% can imagine a use also after practical training.

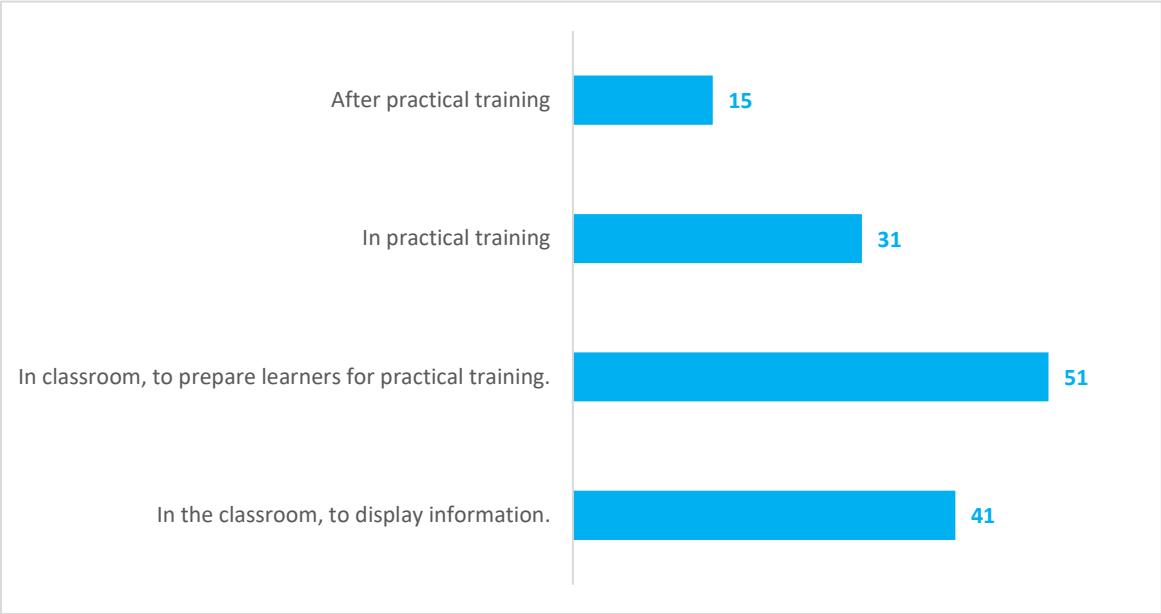


*Figure 1. XR: Where (imagine) to use it?*

To apply XR accordingly the VET teaching personnel should have relevant skills (*see Figure 2 below*). Around 70 % think, that **technical skills** to use the XR devices, the application of XR in different situations to **integrate existing training content** are necessary. This calls for easy-to-use and pedagogic-sound use cases.

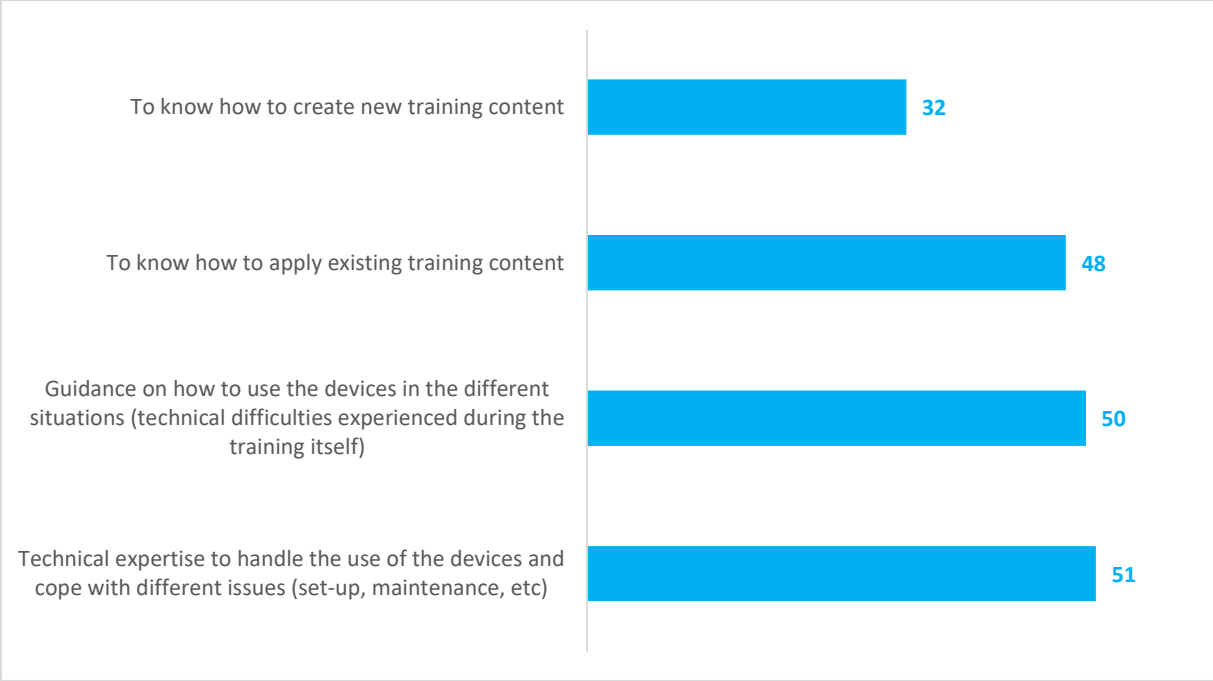


*Figure 2. XR: What are required teacher/trainer skills to use it?*

This requires to understand the **pedagogic-value of XR use for integrating or simulating certain work activities and also alter the XR training content** (*see Figure 3 below*). Soft skills see only 1/3 of the respondents are important. This shows a strong focus on thoughtful integration to reach educational goals.

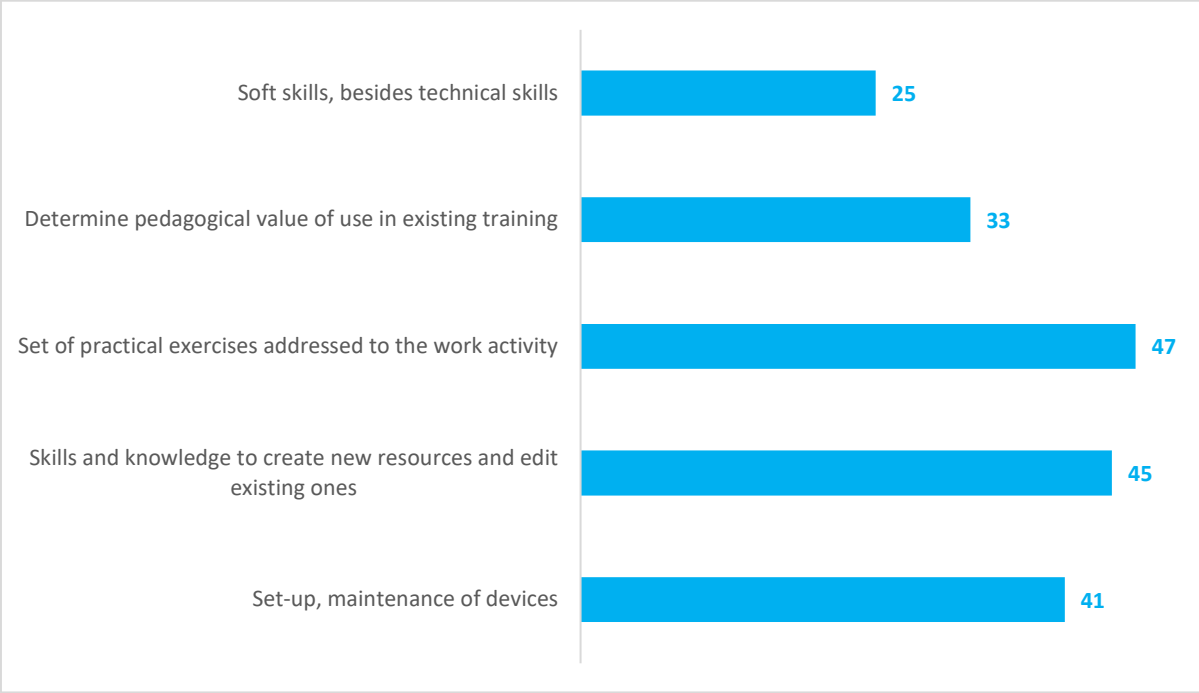


*Figure 3. XR: What is a suitable training purpose, when using it?*

Taking into account professional, social, and digital skills provision and requirements for suitable XR scenarios, the professionals see different use cases (*see Figure 4 below*). The focus in VR and VR haptics is on work process with expensive, complex or dangerous tasks, in contrast to AR with the focus on technical skills provision by a focus on the operation and maintenance of crafts related machines.

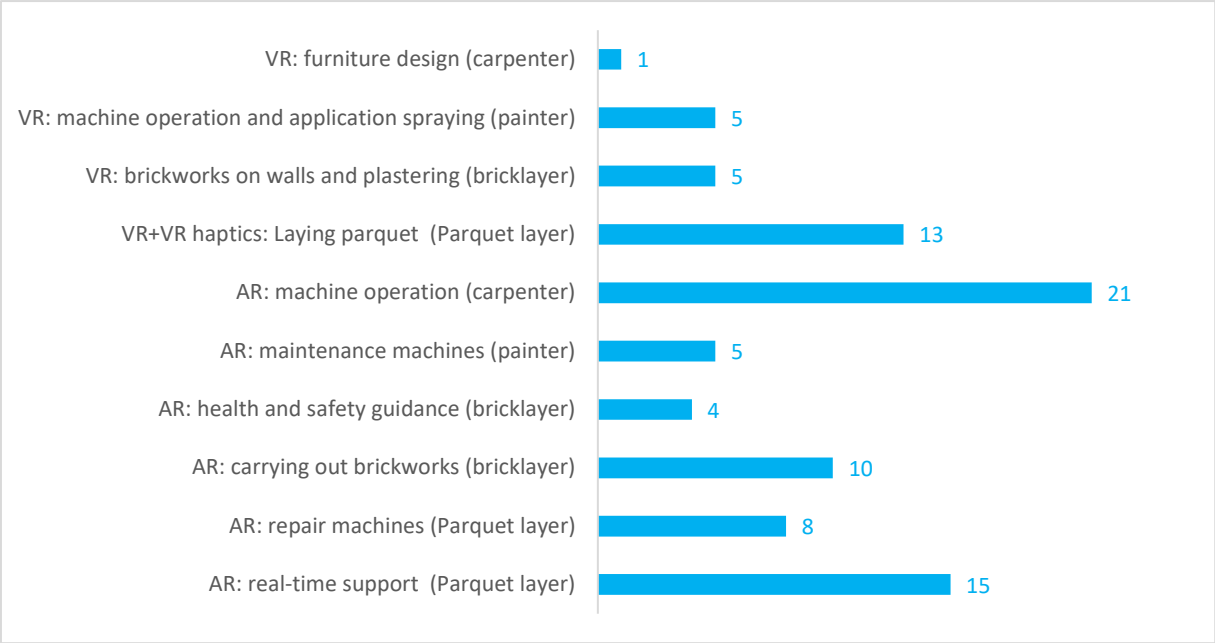


*Figure 4. XR: What are suitable training cases per profession?*

The 9 expert interviews (Belgium: 2, Germany: 2, France: 2, Spain: 3) highlighted some professional related aspects from the online survey.

1. A common theme in using XR is **enhancing practical tasks and technical skills**.

2. For bricklayers the training of apprentices with suitable techniques is central, in contrast to parquet layer with a focus on practical as well as partly dangerous tasks. The simulation of techniques is central for carpenters and the provision of new skills for existing or new techniques see the painter professional as very relevant.

3. **All professionals see a value-added of XR for the creation of interactive teaching and learning scenarios to provide a safer and more engaging learning environment**.

4. Limiting factors are high costs for VR and VR haptics scenario development, and expenditures for XR hardware. In addition, different levels of tech profiency among trainers is seen as a challenge and that XR is used in pedagogic-sound way, and do not causes districtions.

5. Continued exploration and stakeholder coordination are essential for successful implementation.

# Teaching and learning scenario planning

The individual or combined use of virtual reality, virtual reality haptics and augmented reality is intended to support the teaching of technical and media skills as well as communication and collaboration among trainees through learning at learning stations. Self-directed learning and learning in small groups are used here. The trainer supports and moderates this process so that XR can be used in a learning-based manner.

The focus is not to completely replace the current way of teaching, it is on enriching existing teaching and learning scenarios with XR to impart and promote technical, social and digital skills. A 4-stage approach to planning the use of XR is necessary for this.

For example, the use of VR and VR haptics is planned in the practical training of painters and varnishers. The focus is on imparting process knowledge when commissioning the so-called airless high-pressure paint sprayer. The following steps are necessary to realize a learning-based use.

**STEP 1:** What impact is the technology likely to have? Augmentation, as new technologies will improve the transfer of process knowledge with VR

**STEP 2:** What professional, technical and content knowledge should be imparted?
Process knowledge – How to use of the airless (hardware and software) during group work?
Technical knowledge – How to operate VR glasses in combination with VR haptic gloves?

**STEP 3:** What are the learning objectives? (combination of steps 1+2) The choice of technology should complement the practical training. It is important to define for which work steps, which scenario and which type of provision (TAWOCK model) AR, VR and VR haptics are used.

Below are lesson plans for:

I. **Self-directed learning in bricklaying**: focus on working process to build a wall
II. **Collaborative learning in carpentry (among apprentices)**: focus on sanding a wooden surface with a router with guidance by experienced apprentice
III. **Collaborative learning in parquet laying (trainer-apprentice):** focus on laying a parquet with guidance by trainer
IV. **Collaborative learning in painting trade (trainer-apprentice):** focus on learning sequences that tend to be dangerous (airless is a high-pressure device), with guidance by trainer.

Note: A sample evaluation form for self-assessment and observation (trainers) is available in **Annex 3**.

## BRICKLAYING: LAYING A BRICK WALL WITH VR AND VR HAPTICS

| **Dura -tion** | **Learning phase** | **Learning content**<br><br>**(What should the apprentice learn?)** | **Learning activities**<br><br>**(Apprentice actions to meet the objectives?)** | **Teacher/trainer activities**<br><br>**(What is the role of the teacher/trainer and what is he/she going to do?)** | **Communication and collaboration forms** | **Resources, tools, and media**<br><br>**(Which tools or media are used and how are they used?)** |
|---|---|---|---|---|---|---|
| 15 min. | **Intro-duction and Orien-tation** | - Overview of wall laying techniques, tools, and safety precautions. | - Engage in a discussion about wall laying and its importance in construction.<br><br>- Watch a video demonstrating basic wall laying techniques | - Introduce the topic and explain the objectives of the lesson.<br><br>- Show the video and highlight key points.<br><br>- Facilitate a Q&A session to clarify doubts. | - Trainer – single apprentice | - Projector and screen for video.<br><br>- Safety guidelines handouts. |
| 15 min. | **Excecu-tion of the task** | - Hands-on experience with wall laying using Virtual Reality and VR haptics. | - Use VR headset to simulate wall laying scenarios.<br><br>- Practice handling the tools and laying bricks in VR and with VR haptic gloves | - Set up VR equipment and guide apprentices through the VR and VR haptics simulation.<br><br>- Monitor progress and ensure proper use of VR and VR haptics. | - Self-directed learning of apprentice | - VR glasses (e. g. Meta Quest 3)<br><br>- VR haptic gloves (e. g. bHpatics Tactgloves)<br><br>- Bricklaying app |

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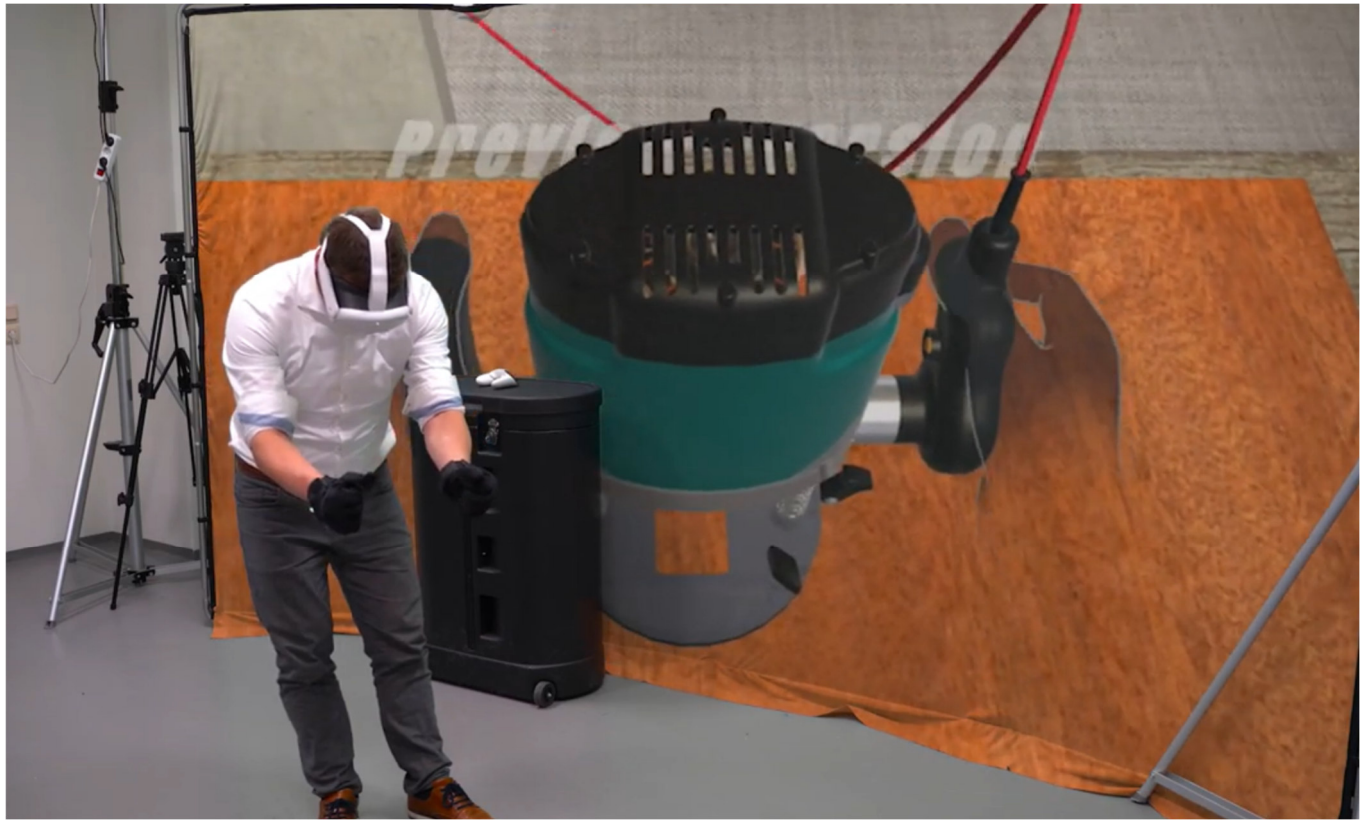
|---|---|---|---|---|---|---|
| 120 min. | **Assess-ment /Check** | - Evaluate understanding and proficiency in laying a wall. | - Demonstrate proficiency in laying a wall in a controlled environment | - Observe and assess the practical demonstration.<br><br>- Provide constructive feedback and additional instruction if necessary | - Practical demonstration by apprentice | - Bricklaying tools and practice materials (e.g., bricks, mortar). |
| 30 min. | **End of the lesson** | - Recap of key points, final Q&A, and feedback session. | - Discuss lessons learned and address any remaining questions.<br><br>- Collect feedback from apprentice VR and VR haptics enriched training session | - Facilitate a feedback session to improve future training.<br><br>- Provide information on further resources and practice opportunities | - Discussion: Trainer -apprentice | - Feedback forms (paper or digital). |



**CARPENTER: ROUTER USE WITH VR AND VR HAPTICS**

| **Dura -tion** | **Learning phase** | **Learning content**<br><br>**(What should the apprentice learn?)** | **Learning activities**<br><br>**(Apprentice actions to meet the objectives?)** | **Teacher/trainer activities**<br><br>**(What is the role of the teacher/trainer and what is he/she going to do?)** | **Communication and collaboration forms** | **Resources, tools, and media**<br><br>**(Which tools or media are used and how are they used?)** |
|---|---|---|---|---|---|---|
| 15 min. | **Intro-duction and Orien-tation** | - Overview of sanding techniques, tools, type of wood and safety precautions for using a router. | - Engage in a discussion about sanding and its importance in carpentry.<br><br>- Watch a video demonstrating basic sanding techniques using a router | - Introduce the topic and explain the objectives of the lesson.<br><br>- Show the video and highlight key points.<br><br>- Facilitate a Q&A session to clarify doubts. | - Interactive discussion.<br><br>- Video presentation | - Projector and screen for video.<br><br>- Safety guidelines handouts |
| 15 min. | **Excecu-tion of the task** | - Hands-on experience with sanding a wooden surface using Virtual Reality and VR haptics. | - Use VR headset to simulate sanding scenarios.<br><br>- Practice handling the router and sanding wooden surfaces in VR and VR haptics | - Set up VR equipment<br><br>- Monitor progress and ensure proper use of VR and VR haptics.<br><br>- Give advice to the learner | - (experienced) apprentice – apprentice;<br><br>The experienced apprentice provides real-time feedback on | - VR glasses (e. g. Meta Quest 3)<br><br>- VR haptic gloves (e.g. bHaptics Tactgloves)<br><br>- VR router training app |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | VR and VR haptics practice | |
| 90 min. | **Assess-ment /Check** | - Evaluate understanding and proficiency in sanding a wooden surface with a router. | - Demonstrate proficiency in sanding a wooden surface in a controlled environment | - Observe and assess the practical demonstration.<br><br>- Provide constructive feedback and additional instruction if necessary | - (experienced) apprentice – apprentice;<br><br>- Practical demonstration. | - Sanding tools and practice materials (e.g., wooden surfaces, routers). |
| 20 min. | **End of the lesson** | - Recap of key points, final Q&A, and feedback session. | - Discuss lessons learned and address any remaining questions.<br><br>- Collect feedback from experienced apprentices on the training session. | - Facilitate a feedback session to improve future training.<br><br>- Provide information on further resources and practice opportunities | - Group discussion. | - Feedback forms (paper or digital). |

## PARQUET LAYER: LAYING A PARQUET WITH VR AND VR HAPTICS

| **Dura -tion** | **Learning phase** | **Learning content**<br><br>**(What should the apprentice learn?)** | **Learning activities**<br><br>**(Apprentice actions to meet the objectives?)** | **Teacher/trainer activities**<br><br>**(What is the role of the teacher/trainer and what is he/she going to do?)** | **Communication and collaboration forms** | **Resources, tools, and media**<br><br>**(Which tools or media are used and how are they used?)** |
|---|---|---|---|---|---|---|
| 15 min. | **Intro-duction and Orien-tation** | - Overview of parquet laying techniques, tools, and safety precautions. | - Engage in a discussion about parquet laying and its importance in flooring.<br><br>- Watch a video demonstrating basic parquet laying techniques. | - Introduce the topic and explain the objectives of the lesson.<br><br>- Show the video and highlight key points.<br><br>- Facilitate a Q&A session to clarify doubts. | - Trainer - apprentice | - Projector and screen for video.<br><br>- Safety guidelines handouts |
| 20 min. | **Excecu-tion of the task** | - Hands-on experience with laying parquet using Virtual Reality and VR haptics. | - Use VR headset and VR haptic gloves to simulate parquet laying scenarios.<br><br>- Practice handling the hard- and software and laying a parquet in VR. | - Set up VR equipment and guide apprentices through the VR simulation.<br><br>- Provide real-time feedback and tips during the VR practice.<br><br>- Monitor progress and ensure proper use of VR haptics | - One-on-one guidance.<br><br>- Small group feedback sessions. | - VR headset (e. g. Meta Quest 3)<br><br>- VR haptic gloves ( e.g. bHaptics Tactgloves)<br><br>- VR parquet laying app |

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|---|---|---|---|---|---|---|
| 120 min. | **Assess-ment /Check** | - Evaluate understanding and proficiency in laying parquet | - Demonstrate proficiency in laying parquet in a controlled environment. | - Observe and assess the practical demonstration.<br><br>- Provide constructive feedback and additional instruction if necessary | - Trainer -apprentice<br><br>- Practical demonstration | - Parquet laying tools and practice materials (e.g., parquet tiles, adhesives). |
| 15 min. | **End of the lesson** | - Recap of key points, final Q&A, and feedback session. | - Discuss lessons learned and address any remaining questions.<br><br>- Collect feedback from apprentices on the training session. | - Facilitate a feedback session to improve future training.<br><br>- Provide information on further resources and practice opportunities. | - Group discussion.<br><br>- Feedback form. | - Feedback forms (paper or digital). |

## PAINTER: USE OF AIRLESS WITH VR AND VR HAPTICS

| **Dura -tion** | **Learning phase** | **Learning content**<br><br>**(What should the apprentice learn?)** | **Learning activities**<br><br>**(Apprentice actions to meet the objectives?)** | **Teacher/trainer activities**<br><br>**(What is the role of the teacher/trainer and what is he/she going to do?)** | **Communication and collaboration forms** | **Resources, tools, and media**<br><br>**(Which tools or media are used and how are they used?)** |
|---|---|---|---|---|---|---|
| 15 min. | **Intro-duction and Orien-tation** | - Overview of airless spraying technology, benefits, and safety precautions. | - Engage in a discussion about the technology and its applications.<br>- Watch a video demonstrating the basics of airless spraying. | - Introduce the topic and explain the objectives of the lesson.<br>- Show the video and highlight key points.<br>- Facilitate a Q&A session to clarify doubts. | - Teacher- apprentice | - Projector and screen for video.<br>- Safety guidelines handouts. |
| 15 min. | **Excecu-tion of the task** | - Hands-on experience with airless spraying using Virtual Reality and VR haptics gloves | - Use VR headset to simulate airless spraying scenarios.<br>- Practice handling the device and spraying techniques in VR and VR haptics to especially operate and feel haptic feedback. | Set up VR equipment and guide apprentices through the VR simulation.<br>- Provide real-time feedback and tips during the VR practice.<br>- Monitor progress and ensure proper use of VR haptics.<br><br>One-on-one guidance.<br>Group feedback sessions. | - Teacher- apprentice (introduction hard- and software)<br><br>- Self-directed (testing it) | - VR glasses (e.g. Meta Quest 3)<br><br>- VR haptic gloves (e.g. bHaptic tactgloves)<br><br>- Tailor-made Airless App<br><br>-External screen to stream inside glass view. |

| | | | | | | |
|---|---|---|---|---|---|---|
| 80 min. | **Assess-ment /Check** | - Evaluate understanding and proficiency with the airless spraying device. | - Demonstrate proficiency with the device in a controlled environment. | - Observe and assess the practical demonstration.<br>- Provide constructive feedback and additional instruction if necessary. | - Self-directed (testing it) | - Airless spraying device and practice materials (e.g. test surfaces). |
| 10 min. | **End of the lesson** | - Recap of key points, final Q&A, and feedback session. | - Discuss lessons learned and address any remaining questions.<br>- Collect feedback from apprentice on the training session. | - Facilitate a feedback session to improve future training. | - Discussion trainer-apprentice | - Discussion notes |

# Conclusions

The use of Extended Reality or XR in practical craftsmanship training requires to:

1. Ask thoughtfull the “WHY” or the pedagogical question: Where XR as an educational technology supports the provision of professional and digital skills as well as fosters collaboration in practical training?

2. Askt he “WHAT” questions concerning Hard- and Software use. AR (Augmented Reality) is the choice for the provision of rather technical knowledge in a low-risk environment DURING practical training. Headset like the Microsoft HoloLens 2 allow a hands-free use and enable no-code and coded solutions. For VR (Virtual Reality) scenarios it is key to focus on knowledge provision for handling rather expensive or risky tasks BEFORE carrying them out during practical training. VR and VR haptics require software programming. The latter when increases the level of training intensity by the provision of haptic feedback or sensations. This trains muscle memory and helps, when carrying out the relevant working task in practice.

The decision on the relevant hardware is also price question. AR headsets are currently more pricy then VR headsets like the Meta Quest 3 (around 500 €). Haptic gloves prices ranges from 300 € (bHaptics Tactgloves pair) to 6000 € (Senseglove Nova 2 pair) and more. As more pricey they are, as more functions they provide. Low-cost haptic gloves like the Tactgloves provide vibrations, Senseglove provides vibrations and so-called forced feedback to “feel” form and function of objects.

3. Ask the “**HOW**” question. This includes to:

a) plan the effect of XR in training e. g. by augmenting an existing lesson by its integration as a learning station during bricklayers, carpenters, parquet layers, and painters training.

b) Formulate your learning objects by using Blooms taxonomy with Augmented Reality: rather on activities such as “**clarify**”, “**carry out**”, “**integrate**” or “**judge**” and Virtual Reality and Virtual Reality haptics rather on activities such as “**recognize**”, “**recall**”, “**summarize**” or “**classify**”.

c) Plan your lesson by integrating AR, VR, and VR haptics in it and evaluate their impact (e.g. questionnaire or discussion)

XR4CRAFTS is an appetizer for the pedagogic-sound use of Extended Reality in VET. The media-didactic concepts applied to bricklaying, carpentry, parquet laying, and painting can be easily transferred to further craftsmanship professions. It is expected to contribute to a more digital enriched teaching and learning from multiple location in real-time, where modern technologies like XR are not just Add-ons, but essential part for a forward-looking and engaging training experience, to support digital transformation within educational institutions as well as on a personal and on a organisational level.

# ANNEXES

# I. Survey

The use of digital media in Vocational training in the trades is mostly limited to software for work organisation, messengers (E.g. Whatsapp) and information offers such as manuals and individual videos. State-of-the-art videos such as Virtual Reality (VR) are rarely in use (4% of 138 companies surveyed) or, as Augmented Reality (AR), represent new territory.

As part of the Erasmus+ Project XR4CRAFTS (2022-1-DE02-KA220-VET-000087844), we would like to provide a virtual training environment to foster the integration of Augmented Reality, Virtual Reality and VR haptics feedback in schools, companies and training provider entities to teach the necessary workforce the needed skills in a safe and virtual environment.

A transnational online survey by the XR4CRAFTS partnership revealed that 96% of the 49 trainers/teachers surveyed were very interested in the theme use of AR/VR and VR haptics.

XR4CRAFTS takes into account the various vocational training systems in the partners' countries and the requirements in the classroom or in the company. These include countries with predominantly school-based VET (Cyprus, Spain) and countries with a Work-based learning share of up to 50% (Belgium, France).

Digital technologies are changing how we live and work. This requires appropriate digital skills. New technologies such as augmented reality (AR) and virtual reality (VR) enable learners to train work processes in advance and learn the appropriate skills to get the job done, whether in practical training or on the construction site.

Virtual Reality is the full immersion of a user in a digital and interactive environment. Augmented Reality is the enrichment of visible reality with digital information. In combination with the latest technologies such as haptic gloves, interactive 3D objects can be felt in VR and AR. This offers qualification opportunities before and during the work execution.

AR Video 1: https://www.youtube.com/watch?v=1yEOjHUgwP4 (Live support)

VR Video: https://www.youtube.com/watch?v=SQ9Tvi7vVfY (underground preparation)

To determine your needs, please answer the short questionnaire. (9 minutes)

Thank you for answering.

1. Organisation.

   _____

2. Are you a company, school or other?
   a. Company
   b. School

   If other, please specify.

   _____

3. What is your role?

   a. Teacher/trainer
   b. Foreman
   c. Company owner/manager
   d. Others (please specify):

4. How many years of experience do you have dealing with AR/VR/VR haptics?
   a. 0 years
   b. < 1 year
   c. 1-3 years
   d. > 3 years

5. Do you have experience in training using AR/VR/VR haptics?
   a. Yes
   b. No, but I know or tried out AR/VR or VR haptics

   If yes, what was this training and to whom was it addressed?

   _____

6. How do you use or can imagine using AR/VR/haptics (in training, if possible)?
   a. In the classroom, to display information.
   b. In classroom, to prepare learners for practical training.
   c. In practical training
   d. After practical training
7. What skills should the teacher/trainer have to use AR/VR/VR haptics correctly in training?

   a. Technical expertise to handle the use of the devices and cope with different issues (set-up, maintenance, etc)
   b. Guidance on how to use the devices in the different situations (technical difficulties experienced during the training itself)
   c. To know how to apply existing training content
   d. To know how to create new training content

8. What are suitable training case or training scenarios in your profession to use AR/VR/VR haptics?

9. Do you find the following scenarios suitable for carpenter/bricklayer/parquet installer/painter?

   Carpenter:

   AR: assembly of stains and wooden structures
   AR: health and safety
   VR+ VR haptics: Assembly of wooden constructions
   VR+ VR haptics: use of woodworking machines

   Bricklayer:

   AR: carrying out brickworks
   AR: health and safety guidance
   VR+VR haptics: brickworks on walls and plastering

   Parquet installer:

   AR: real time support, when gluing, grinding, finishing, laminating
   AR: repair machines
   VR + VR haptics: Laying parquet
   VR+VR haptics: working with woodworking machines

   Painter:

   AR: handling of machines
   AR: Health and Safety
   VR+VR haptics: underground preparation and painting of undergrounds
   VR+VR haptics: window painting

10. What is the expected pedagogical value of using VR/AR/haptics (in training)?
    a. To experience what is like to be in a real working environment
    b. Higher confidence of learners due to the repetition in the safe virtual environment
    c. Making mistakes and learn from them
    d. Higher concentration of learners, better transfer of knowledge at the workplace
    e. Learners are higher motivated by using AR/VR/haptics rather than other technologies

11. What do you think is the main reason to implement VR/AR/haptics in training?
    a. To bring the learner closer to a real work environment and real work tasks
    b. To foster learner confidence performing the tasks
    c. To motivate learners using technology
    d. Others (please specify): _____

12. In your opinion, what training content should be included in a comprehensive training for using of AR/VR/haptics?

a. Set-up, maintenance of devices
b. Skills and knowledge to create new resources and edit existing ones
c. Set of practical exercises addressed to the work activity
d. Determine pedagogical value of use in existing training
e. Soft skills, besides technical skills

13. Are you interested in the survey results, please leave your e-mail address here (optional question):

_____

**Thank you**

# II. Interview Guidelines

<<XR4CRAFTS – Extended Reality (XR) for Craftmanship Training>> is a European project co-funded under the Erasmus+ programme to be developed during 2022 and 2024. The partnership is based by 5 different institutions from 5 different European countries: Germany, Belgium, Cyprus, France and Spain. SBD Dresden is the project Coordinator.

The main objective of this project is to document and showcase the traditional skills and techniques of four different professions as bricklayer, carpenter, painter and varnisher, and parquet installer.

Knowledge of techniques and skills needed will be captured in the form of interviews which will then be published on the internet. This is intended to create new qualification and interactive training materials for students and professionals on the field.

The overall aim is to transfer knowledge to younger generations through the use of new technologies, and in short, to promote sustainable and profitable professions that strengthen crafts work.

- *The interview*

Through this interview we would like to know more about your profession, or how your current profession compares to it. We would like to talk about your knowledge, your skills and techniques concerning the use of VR, AR or VR haptics on training. Thank you for agreeing to be interviewed.

We would like to record the entire interview so we can get the most out of your most authentic knowledge and experiences. You will be provided with access to interviews of this style that are also being conducted in other European countries. To enable us to better compare the interviews, we would like to follow a series of questions about your work (these are listed below).

The list of questions is quite extensive and exhaustive. The questions focus on such disparate aspects as your personal experience, your working place, your knowledge e and skills, and how you perceive the profession today and your prognosis for the future.

You can choose not to have us ask some of the questions or you can choose not to answer a question at any time. Feel free to add anything you feel appropriate if you are missing information or details. As the interview is quite long, we may take one or two breaks as needed.

In accordance with the General Data Protection Register (GDPR)m we will ask for your written consent before we start recording this interview (below).

- *Background information for the interview*

| Subject | Information |
|---|---|
| Location | |
| Date, Time | |
| Camera (if necessary) | |
| Person being interviewed (name, address, age, gender) | |
| Other persons present/involved | |

| | |
|---|---|
| Notes on the context of this interview (personal history, curriculum vitae, etc) | |
| Other notes (if necessary) | |
| GDPR Consent | The interviewee consents to the recording of the interview in accordance with the Privacy Policy and Terms of Use of the XR4CRAFTS Project based on the European Commission's GDPR data privacy regulation.<br>Date:<br>Signature of the interviewee:<br>_____ |
| Confirmation | Signature of the interviewer:<br>_____ |

- *Draft of Questions*

Various benefits of using AR/MR in education are mentioned throughout the literature. Following key benefits have been identified by Alzahrani in conducted systematic literature reviews[1]:

- Allows more efficient visualisation
- Allows distance & remote learning due to portability and convenience
- Allows student-centred learning
- Boosts students' motivation and engagement
- Enhances collaborative learning
- Enhances knowledge retention and spatial abilities
- Increases student's physical interactions and concentration
- Increases learning satisfaction
- Increases interactivity and information accessibility
- Supports kinesthetic learning
- Supports creative learning
- Students can gather first-hand experience in subjects which would not be possible otherwise
- Self-paced learning for students

The Interview guideline is structured according to Misoch[2] in four phases: information phase, warm-up, main phase and end note. The information phase is the introductory talk of the interview, where the participants are informed about the study and the data handling. The other three phases contain the interview questions as following:

| | |
|---|---|
| Warm-up | 1. Could please explain what is your job/position?<br>2. Did you have experience with AR/VR/VR haptics? |

[1] Alzahrani, N. M.: 'Augmented Reality: A Systematic Review of Its Benefits and Challengesin E-learning Contexts', Applied Sciences, vol. 10, no. 16, Art. no. 16, Jan. 2020, doi:10.3390/app10165660

[2] Misoch, S.: Qualitative Interviews, 2., Erweiterte und aktualisierte Auflage. De GruyterOldenbourg, 2019. [Online]. Available: https://ak.overdrive.com/media/4868011

| | |
|---|---|
| | 3. If yes: Could you, please explain how you first got the idea of incorporating AR/VR/haptics into classroom or practical training?<br>If no: How you can imagine using AR/VR/VR haptics in training?<br>4. In which courses or tasks, you can imagine using AR/VR/VR haptics?<br>5. In which ways do you perform or can imagine performing AR/VR/haptics? (interactive, passive, quizzes…)<br>6. For what kind of content do you use or can imagine using AR/VR/haptics? Is it or should it self-created? |
| Main phase | 7. What benefits do you see or expect when using AR/VR/haptics in training?<br>8. Do you have any particular approach/method for creating AR/VR/haptics experiences?<br>9. What challenges have you or expect to encounter when applying AR/VR/haptics in your lessons? |
| End note | 10. To conclude this interview, do you want to add a topic that is important from your point of view, which we have not touched yet? |

- *Closing the interview*

1. This interview will be analysed, summarised, translated and edited. Some clarification may be needed by phone or email. The interviewee will be able to view the final results of the interview before it is published.
2. If you have questions about anything, you may contact the interviewer.

# III. Evaluation forms templates

## VR + VR haptics scenario: _____

Please cross the relevant answer.

| Question | Very much/ A lot | | | | Not at all |
|---|---|---|---|---|---|
| Was it easy to use the VR glass? | | | | | |
| Was it easy to use the VR app? | | | | | |
| Was it easy to move from one step to the next step in the VR app also by using VR haptic gloves? | | | | | |
| Did you find it comfortable to wear the VR glasses (Meta Quest 3) and the VR haptic gloves? | | | | | |
| Do you feel that your understanding of the topic has increased by the provided content or setting when using VR haptic gloves? | | | | | |
| Was it easy to move on after mistakes or misunderstandings? | | | | | |
| How satisfied are you with your performance of the tasks using the VR glass and the VR haptic gloves? | | | | | |
| How confident are you that your learners will be able to use what you have learned today for your work? | | | | | |
| Did the scenario helps to reach the learning goal (provision of process knowledge, collaboration, …) better? | | | | | |
| Do you find the scenario motivating? | | | | | |

Comments (optional):

## AR scenario: _____

Please cross the relevant answer.

| Question | Very much/ A lot | | | | Not at all |
|---|---|---|---|---|---|
| Was it easy to use the AR headset? | | | | | |
| Was it easy to use the AR app? | | | | | |
| Was it easy to move from one step to the next step in the AR app? | | | | | |
| Did you find it comfortable to wear the AR glasses (Microsoft HoloLens 2)? | | | | | |
| Do you feel that your understanding of the topic has increased by the provided content or setting when using AR glasses gloves? | | | | | |
| Was it easy to move on after mistakes or misunderstandings? | | | | | |
| How satisfied are you with your performance of the tasks using the AR glass? | | | | | |
| How confident are you that your learners will be able to use what you have learned today for your work? | | | | | |
| Did the scenario helps to reach the learning goal (provision of process knowledge, collaboration, …) better? | | | | | |
| Do you find the scenario motivating? | | | | | |

Comments (optional):