



## SCENARIO GUIDEBOOK

Extended Reality (XR) and XR haptics application in craftsmanship training





*XR4CRAFTS is funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.*



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## Foreword

The scenario guide presents all teaching and learning scenarios developed, tested and evaluated as part of the XR4CRAFTS project. The focus was on a **learning-based integration** of augmented reality (AR), virtual reality (VR) and virtual reality haptics into practical training. Target occupations were: bricklayer, painter and varnisher, parquet fitter and carpenter. This led to improved motivation among the trainees, more efficient task execution and, by promoting self-directed learning and learning in small groups, to better imparting professional skills.

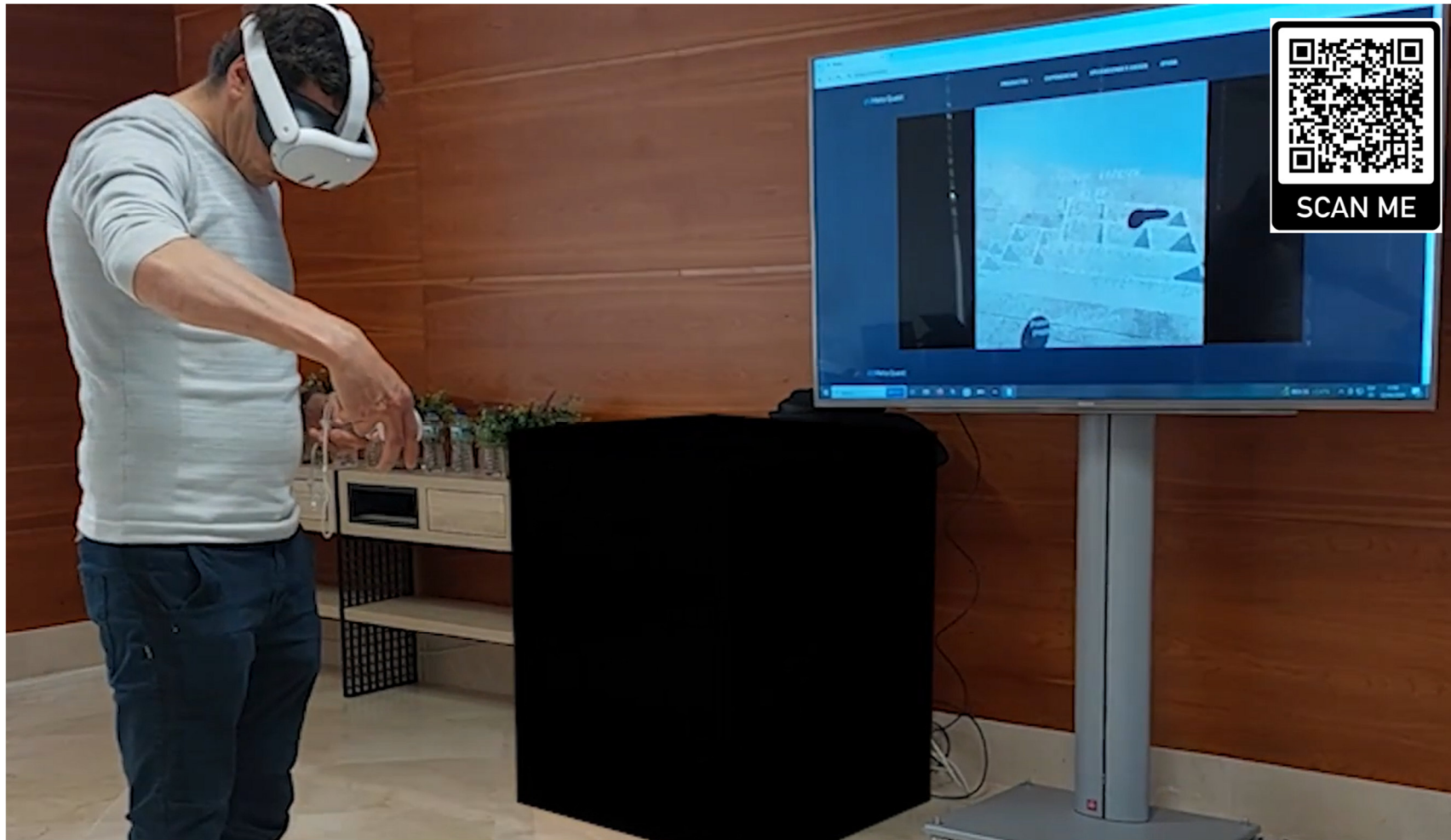
Each scenario is presented with a name, corresponding learning video and the associated lesson plan.

**The information and materials provided directly support vocational training staff in the integration of modern educational technologies into practical training in the skilled trades.**

Enjoy reading!

## Scenario I: Bricklayer – Building a wall in VR (self-guided)

Pedagogical problem: How can VR be used in self-directed learning to impart professional competence?



<b>Length of time</b>	<b>learning phase</b>	<b>learning content</b> (What should the trainee learn?)	<b>learner activities</b> (Trainee measures to achieve goals?)	<b>trainer activities</b> (What is the role of the trainer and what will he/she do?)	<b>forms of communication and cooperation</b>	<b>resources, tools and media</b> (What tools or media are used and how are they used?)
20 minutes	<b>Introduction and orientation</b>	- Overview of masonry techniques, tools and safety precautions.	- Watch a video demonstrating basic masonry techniques	- Introduction to the topic and explanation of the course objectives  - Play Video  - Allow a question and answer session to clear up any doubts.	- Individual trainee	- Projector and screen for video.  - Handouts with safety guidelines.
15 minutes	<b>execution of the task</b>	- Practical experience in building a wall using virtual reality.	- Using the VR headset to simulate wall laying scenarios.  - Practice using the tools and laying bricks in VR and with VR controllers	- Setting up VR glasses and handing over VR glasses and app to trainees  - Monitoring progress and ensuring VR and VR haptics are used correctly.	- Self-directed learning of the trainee	- VR glasses (e.g. Meta Quest 3 and controller)  - Maurer-VR App
10 minutes	<b>Assessment / control</b>	- Assessment of understanding and competence	- Demonstrate competence in building a wall in a controlled environment	- Observation and evaluation of the practical demonstration.  - Provide constructive feedback and additional instructions	- Practical demonstration by trainees	- Bricklaying tools and training materials (e.g. bricks, mortar).

## Scenario II: Bricklayer – Building a wall in VR (Trainer-Trainee)

Pedagogical problem: How can VR be used between trainer and trainee to impart professional competence?



<b>Length of time</b>	<b>learning phase</b>	<b>learning content</b> (What should the trainee learn?)	<b>learner activities</b> (Trainee measures to achieve goals?)	<b>trainer activities</b> (What is the role of the trainer and what will he/she do?)	<b>forms of communication and cooperation</b>	<b>resources, tools and media</b> (What tools or media are used and how are they used?)
20 minutes	<b>Introduction and orientation</b>	- Overview of masonry techniques, tools and safety precautions.	- Participation in discussion about the building of a wall and its significance in construction.  - Watch a video demonstrating basic masonry techniques	- Introduction to the topic and explanation of the course objectives  - Play Video  - Allow a question and answer session to clear up any doubts.	- Trainer – individual trainee	- Projector and screen for video.  - Handouts with safety guidelines.
15 minutes	<b>execution of the task</b>	- Practical experience in building a wall using virtual reality.	- Using the VR headset to simulate wall laying scenarios.  - Practice using the tools and laying bricks in VR and with VR controllers under the supervision of the instructor	- Setting up VR devices and guiding trainees through the VR app.  - Monitoring progress and ensuring VR and VR haptics are used correctly.	- Trainer – individual trainee	- VR glasses (e.g. Meta Quest 3 and controller)  - Maurer-VR App



10 minut es	<b>Assess- ment / control</b>	- Assessment of understanding and competence	- Demonstrate competence in building a wall in a controlled environment	- Observation and evaluation of the practical demonstration.  - Provide constructive feedback and additional instructions	- Practical demonstration by trainees	- Bricklaying tools and training materials (e.g. bricks, mortar).
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## Scenario III: Bricklayer – Building a Wall in VR (Peer Learning)

Pedagogical problem: How can VR be used to transfer knowledge between experienced and inexperienced trainees?

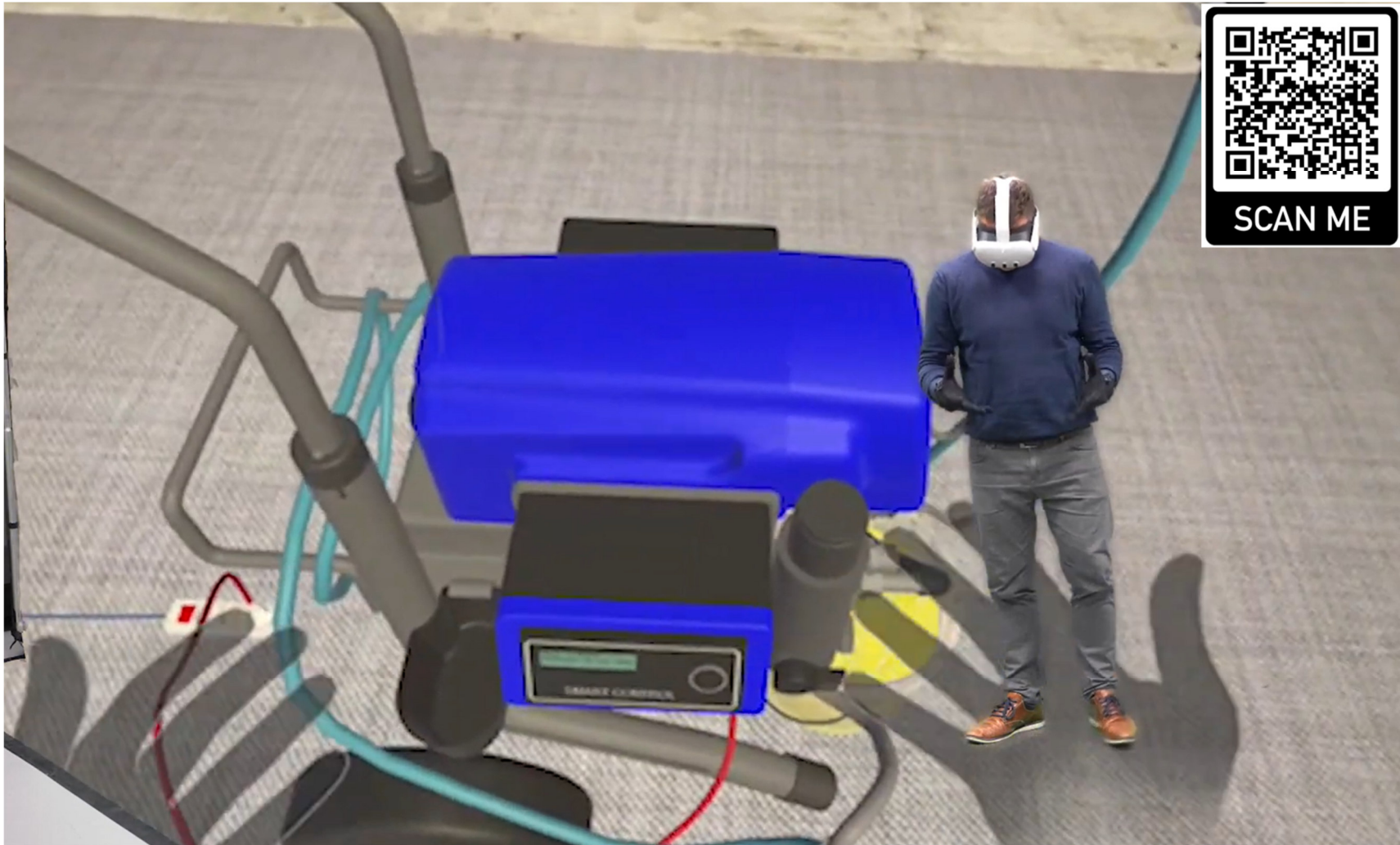


<b>Length of time</b>	<b>learning phase</b>	<b>learning content</b> (What should the trainee learn?)	<b>learner activities</b> (Trainee measures to achieve goals?)	<b>trainer activities</b> (What is the role of the trainer and what will he/she do?)	<b>forms of communication and cooperation</b>	<b>resources, tools and media</b> (What tools or media are used and how are they used?)
20 minutes	<b>Introduction and orientation</b>	- Overview of masonry techniques, tools and safety precautions.	- Participation in discussion among trainees about building a wall  - Watch a video demonstrating basic masonry techniques	- Introduction to the topic and explanation of the course objectives  - Play Video  - Allow a question and answer session to clear up any doubts.	- Experienced trainee - trainee	- Projector and screen for video.  - Handouts with safety guidelines.
15 minutes	<b>execution of the task</b>	- Practical experience in building a wall using virtual reality.	- Using the VR headset to simulate bricklaying scenarios.  - Practice using the tools and laying bricks in VR and with VR controllers under the supervision of the instructor	- Setting up VR devices and guiding trainees through the VR app.  - Monitoring progress and ensuring VR and VR haptics are used correctly.	- Experienced trainee - trainee	- VR glasses (e.g. Meta Quest 3 and controller)  - Maurer-VR App

10 minut es	<b>Assess- ment / control</b>	- Assessment of understanding and competence	- Demonstrate competence in building a wall in a controlled environment	- Observation and evaluation of the practical demonstration.  - Provide constructive feedback and additional instructions	- Practical demonstration by the trainees	- Bricklaying tools and training materials (e.g. bricks, mortar).
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## Scenario IV: Painters and varnishers – Airless operation with VR and VR haptics (self-controlled)

Pedagogical problem: How can VR be used in self-directed learning to impart professional competence?

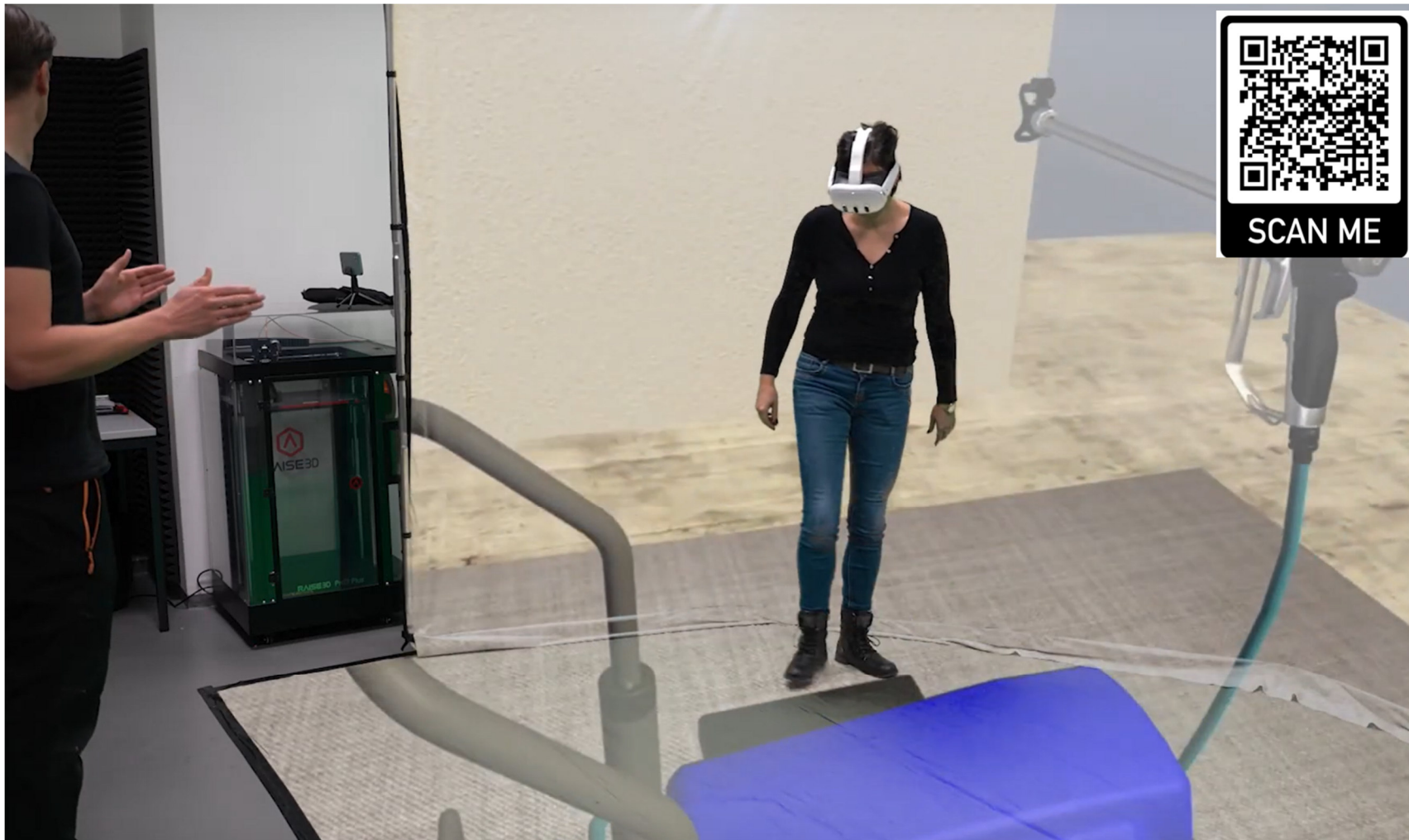


<b>Length of time</b>	<b>learning phase</b>	<b>learning content</b> (What should the trainee learn?)	<b>learner activities</b> (Trainee measures to achieve goals?)	<b>trainer activities</b> (What is the role of the trainer and what will he/she do?)	<b>forms of communication and cooperation</b>	<b>resources, tools and media</b> (What tools or media are used and how are they used?)
20 minutes	<b>Introduction and orientation</b>	- Overview Airless, safety precautions.	- Participation in discussion on airless application.  - Watch a video demonstrating the basics of airless application.	- Introduction of topic and explanation of course objectives  - Play video  - Enable question and answer sessions to clear up any doubts.	- Self-directed	- Projector and screen for video.  - Handouts with safety guidelines.
15 minutes	<b>execution of the task</b>	- Hands-on experience with Airless using Virtual Reality and VR haptic gloves	- Use VR headset to simulate airless use.  - Practice handling the device and coating techniques in VR and VR haptics, especially to get haptic feedback.	- Setting up VR and VR haptic gloves and guiding trainees through the VR simulation.  - Provide real-time feedback and tips.  - Monitoring progress and ensuring that VR and VR haptics are used correctly.  - Personal advice. Group feedback sessions.	- Self-directed	- VR glasses (e.g. Meta Quest 3)  - VR haptic gloves (e.g. bHaptic tactgloves)  - Tailor-made Airless App  - External screen for streaming in glass view.

10 minut es	<b>Assess- ment / control</b>	- Assess your understanding of how to use Airless.	- Demonstration of knowledge in handling the device in a controlled environment.	- Observation and evaluation of the practical demonstration.  - Providing constructive feedback.	- Self-directed	- Airless sprayer and training materials (e.g. test surfaces).
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## Scenario V: Painters and varnishers – Airless operation with VR (trainer- trainee)

Pedagogical problem: How can VR be used to impart and subsequently apply professional knowledge in advised learning?



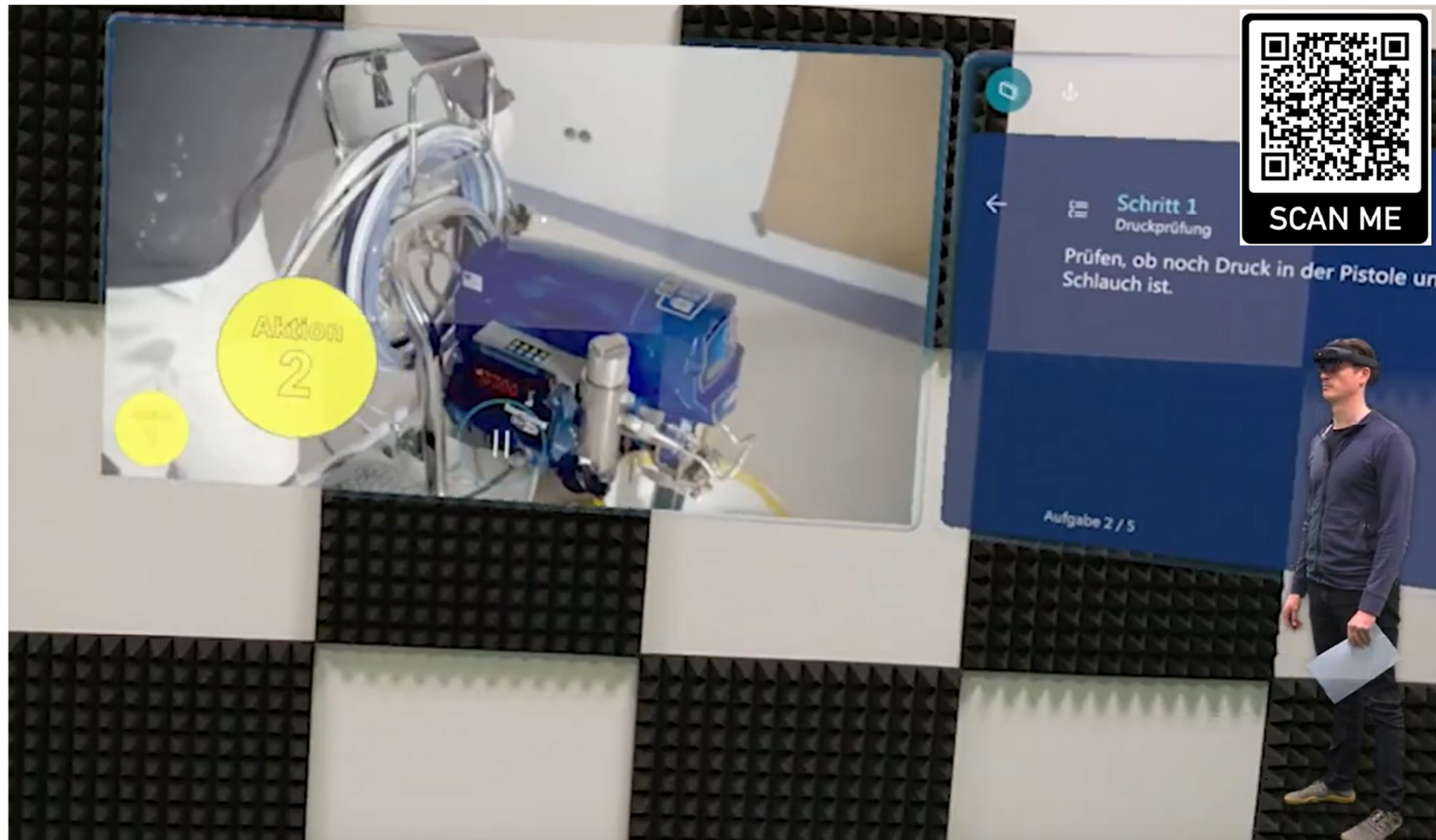


<b>Length of time</b>	<b>learning phase</b>	<b>learning content</b> (What should the trainee learn?)	<b>learner activities</b> (Trainee measures to achieve goals?)	<b>trainer activities</b> (What is the role of the trainer and what will he/she do?)	<b>forms of communication and cooperation</b>	<b>resources, tools and media</b> (What tools or media are used and how are they used?)
20 minutes	<b>Introduction and orientation</b>	- Overview Airless, safety precautions.	- Participation in discussion on airless application.  - Watch a video demonstrating the basics of airless application.	- Introduction of topic and explanation of course objectives  - Play video  - Allow a question and answer session to clear up any doubts.	- Trainer - Trainee	- Projector and screen for video.- Handouts with safety guidelines.
15 minutes	<b>execution of the task</b>	- Hands-on experience with Airless using Virtual Reality and VR haptic gloves	- Use VR headset to simulate airless use.  - Practice handling the device and coating techniques in VR and VR haptics, especially to get haptic feedback.	- Setting up VR and VR haptic gloves and guiding trainees through the VR simulation.  - Provide real-time feedback and tips.  - Monitoring progress and ensuring that VR and VR haptics are used correctly.  - Personal advice. Group feedback sessions.	- Trainer and trainee (introduction to hardware and software)  - Self-directed (testing)	- VR glasses (e.g. Meta Quest 3)  - VR haptic gloves (e.g. bHaptic tactgloves)  - Tailor-made Airless App  - External screen for streaming in glass view.

10 minut es	<b>Assess- ment / control</b>	- Assess understanding of Airless handling.	- Demonstration of knowledge in handling the device in a controlled environment.	- Observation and evaluation of the practical demonstration.  - Providing constructive feedback.	- Self-directed (testing)	- Airless sprayer and training materials (e.g. test surfaces).
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## Scenario VI: Painters and varnishers – Commissioning Airless with AR Guides (self-controlled)

Pedagogical problem: How can AR be used to impart and subsequently apply professional knowledge in self-directed learning?



<b>Length of time</b>	<b>learning phase</b>	<b>learning content</b> (What should the trainee learn?)	<b>learner activities</b> (Trainee measures to achieve goals?)	<b>trainer activities</b> (What is the role of the trainer and what will he/she do?)	<b>forms of communication and cooperation</b>	<b>resources, tools and media</b> (What tools or media are used and how are they used?)
20 minutes	<b>introduction and orientation</b>	- Overview Airless, safety precautions.	- Participation in discussion on airless application.  - Watch a video demonstrating the basics of airless application.	- Introduction of topic and explanation of course objectives  - Play video  - Creating airless instructions in Microsoft Guides software on the PC	- Self-directed	- Projector and screen for video.  - Handouts with safety guidelines.
15 minutes	<b>task execution</b>	- Hands-on experience with augmented reality	- Use AR headset and Microsoft Guides app to implement airless start	- Setting up Microsoft HoloLens 2 and Microsoft Guides app	- Self-directed	- Microsoft HoloLens 2  - Microsoft Guides app
10 minutes	<b>assessment / examination</b>	- Assess understanding of how to use Airless.	- Demonstration of knowledge in handling the device after viewing a work step in the MS Guides app	- Providing constructive feedback.	- Self-directed	- Airless sprayer and training materials (e.g. test surfaces).

## Scenario VII: Parquet fitter – laying parquet with VR (self-controlled)

Pedagogical problem: How can VR and VR haptics be used in self-directed learning to impart professional competence?



<b>Length of time</b>	<b>learning phase</b>	<b>learning content</b> (What should the trainee learn?)	<b>learner activities</b> (Trainee measures to achieve goals?)	<b>trainer activities</b> (What is the role of the trainer and what will he/she do?)	<b>forms of communication and cooperation</b>	<b>resources, tools and media</b> (What tools or media are used and how are they used?)
20 minutes	<b>Introduction and orientation</b>	- Overview of parquet laying techniques, tools and safety precautions.	- Discussion of parquet flooring  - Watch a video demonstrating the basic techniques of laying parquet.	- Introduction to the topic and explanation of the objectives of the lesson.  - Play video.  - Allow a question and answer session to address any potential questions.	- Self-directed	- Projector and screen for video.  - Handouts on security guidelines
15 minutes	<b>task execution</b>	- Practical experience with laying parquet using virtual reality.	- Use VR headset and controller to simulate parquet laying scenarios.  - Practice using the hardware and software and laying a parquet floor in VR.	- Setting up VR device and guiding trainees through VR simulation.  - Give feedback during VR training  - Monitoring progress and ensuring VR is used properly.	- Self-directed	- VR headset (e.g. Meta Quest 3)  - VR app for parquet laying

10 minut es	<b>assessme nt / examinati on</b>	- Assessment of understanding and competence in laying parquet	- Demonstration of knowledge on laying parquet in a controlled environment (reality).	- Observation and evaluation of practical demonstration.  Constructive feedback and additional instructions when needed.	- Self-directed	- Parquet laying tools and training materials (e.g. parquet tiles, adhesives).
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## Scenario VIII: Parquet fitter – laying parquet with VR and VR haptics (peer learning)

Pedagogical problem: How can VR and VR haptics be used in small groups to impart professional competence?





<b>Length of time</b>	<b>learning phase</b>	<b>learning content</b> (What should the trainee learn?)	<b>learner activities</b> (Trainee measures to achieve goals?)	<b>trainer activities</b> (What is the role of the trainer and what will he/she do?)	<b>forms of communication and cooperation</b>	<b>resources, tools and media</b> (What tools or media are used and how are they used?)
20 minutes	<b>Introduction and orientation</b>	- Overview of parquet laying techniques, tools and safety precautions.	- Discussion of parquet flooring - Watch a video demonstrating the basic techniques of parquet installation.	- Introduction to the topic and explanation of the objectives of the lesson.  - Play video.  - Allow a question and answer session to address any potential questions.	- Experienced trainee - trainee	- Projector and screen for video.  - Handouts on security guidelines
15 minutes	<b>task execution</b>	- Practical experience with laying parquet using virtual reality and VR haptics.	- Use VR headset and VR haptic gloves to simulate parquet laying scenarios.  - Practice using the hardware and software and laying a parquet floor in VR.	- Setting up VR device and guiding trainees through VR simulation.  - Give feedback during VR training  - Monitoring progress and ensuring VR and VR haptics are used properly.	- Experienced trainee - trainee	- VR headset (e.g. Meta Quest 3)  - VR haptic gloves (e.g. bHaptics Tactgloves)  - VR app for parquet laying

10 minut es	<b>assessme nt / examinati on</b>	- Assessment of understanding and competence in laying parquet	- Demonstration of knowledge on laying parquet in a controlled environment (reality).	- Observation and evaluation of practical demonstration.  Constructive feedback and additional instructions when needed .	- Experienced trainee - trainee	- Parquet laying tools and training materials (e.g. parquet tiles, adhesives).
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## Scenario IX: Parquet fitter – laying parquet with VR (trainer-trainee)

Pedagogical problem: How can VR and VR haptics be used in 1:1 settings to impart professional skills?



<b>Length of time</b>	<b>learning phase</b>	<b>learning content</b> (What should the trainee learn?)	<b>learner activities</b> (Trainee measures to achieve goals?)	<b>trainer activities</b> (What is the role of the trainer and what will he/she do?)	<b>forms of communication and cooperation</b>	<b>resources, tools and media</b> (What tools or media are used and how are they used?)
20 minutes	<b>introduction and orientation</b>	- Overview of parquet laying techniques, tools and safety precautions.	- Discussion of parquet flooring  - Watch a video demonstrating the basic techniques of parquet installation.	- Introduce the topic and explain the objectives of the lesson.  - Play video.  - Allow a question and answer session to address any potential questions.	- Trainer - Trainee	- Projector and screen for video.  - Handouts on security guidelines
60 minutes	<b>task execution</b>	- Practical experience with laying parquet using virtual reality and VR haptics.	- Use VR headset and VR haptic gloves to simulate parquet laying scenarios.  - Practice using the hardware and software and laying a parquet floor in VR.	- Setting up VR device and guiding trainees through VR simulation.  - Give feedback during VR training  - Monitoring progress and ensuring VR and VR haptics are used properly.	- Personal advice	- VR headset (e.g. Meta Quest 3)  - VR haptic gloves (e.g. bHaptics Tactgloves)  - VR app for parquet laying

30 minut es	<b>assessme nt / examinati on</b>	- Assessment of understanding and competence in laying parquet	- Demonstration of knowledge on laying parquet in a controlled environment (reality).	- Observation and evaluation of practical demonstration.  Provide constructive feedback and additional instructions when needed .	- Trainer - Trainee  - Practical demonstration	- Parquet laying tools and training materials (e.g. parquet tiles, adhesives).
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## Scenario X: Carpenter – Operating a router with VR and VR haptics (self-controlled)

Pedagogical problem: How can VR and VR haptics be used in self-directed learning to impart professional competence?



<b>Le- ngth of time</b>	<b>learning phase</b>	<b>learning content</b>  (What should the trainee learn?)	<b>learner activities</b>  (Trainee measures to achieve goals?)	<b>trainer activities</b>  (What is the role of the trainer and what will he/she do?)	<b>forms of communication and cooperation</b>	<b>resources, tools and media</b>  (What tools or media are used and how are they used?)
20 minutes	<b>Intro- duction and orient- ation</b>	- Overview of sanding techniques, tools, wood types and occupational safety regulations for using a router.	- Participation in discussion on grinding and its importance for the carpentry trade  - Watch a video demonstrating basic sanding techniques using a router.	- Introduction to the topic and explanation of the objectives of the lesson.  - Play Video  - Allow a question and answer session to address any potential questions.	- Self-directed	- Projector and screen for video.  - Handouts on security guidelines
300 minutes	<b>execution of the task</b>	- Carrying out the grinding process with a router using virtual reality and VR haptics.	- Use a VR headset and VR haptic gloves to simulate the desired grinding scenario.  - Practice using the router and sanding wooden surfaces in VR and VR haptics	- VR setup and VR haptics  - Monitoring progress and ensuring VR and VR haptics are used correctly.	- Self-directed	- VR glasses (e.g. Meta Quest 3)  - VR haptic gloves (e.g. bHaptics Tactgloves)  - VR router training app
10 minutes	<b>Assess- ment / control</b>	- Assessment of understanding and competence in using router	- Demonstration of skills in sanding a wooden surface in a controlled environment (in reality)	- Observation and evaluation of practical demonstration.  Constructive feedback and additional instructions if necessary	- Self-directed - Demonstration	- Grinding tools and training materials (e.g. routers).

## Scenario XI: Carpenter – Operating a router with VR and VR haptics (peer learning)

Pedagogical problem: How can VR and VR haptics be used in 1:1 settings to impart professional skills?





<b>Length of time</b>	<b>learning phase</b>	<b>learning content</b> (What should the trainee learn?)	<b>learner activities</b> (Trainee measures to achieve goals?)	<b>trainer activities</b> (What is the role of the trainer and what will he/she do?)	<b>forms of communication and cooperation</b>	<b>resources, tools and media</b> (What tools or media are used and how are they used?)
10 minutes	<b>Introduction and orientation</b>	- Overview of sanding techniques, tools, wood types and occupational safety regulations for using a router.	- Participation in discussion on grinding and its importance for the carpentry trade  - Watch a video demonstrating basic sanding techniques using a router.	- Introduction to the topic and explanation of the objectives of the lesson.  - Play Video  - Allow a question and answer session to address any potential questions.	- Interactive discussion.  - Video presentation	- Projector and screen for video.  - Handouts on security guidelines
90 minutes	<b>execution of the task</b>	- Carrying out the grinding process with a router using virtual reality and VR haptics.	- Use a VR headset and VR haptic gloves to simulate the desired grinding scenario.  - Practice using the router and sanding wooden surfaces in VR and VR haptics	- VR setup and VR haptics  - Monitoring progress and ensuring VR and VR haptics are used correctly.	- (Experienced) trainee – apprentice;  The experienced trainee provides real-time feedback on VR and VR haptics usage	- VR glasses (e.g. Meta Quest 3)  - VR haptic gloves (e.g. bHaptics Tactgloves)  - VR router training app

20 minut es	<b>Assess- ment / control</b>	- Assessment of understanding and competence in using router	- Demonstration of skills in sanding a wooden surface in a controlled environment (in reality)	- Observation and evaluation of practical demonstration.  Constructive feedback and additional instructions if necessary	- (experienced) trainee – apprentice;  - Practical demonstration.	- Grinding tools and training materials (e.g. routers).
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## Scenario XII: Carpenter – Operating a router with VR and VR haptics (trainer – several trainees)

Pedagogical problem: How can VR and VR haptics be used to train small groups using an instructor?



<b>Length of time</b>	<b>learning phase</b>	<b>learning content</b> (What should the trainee learn?)	<b>learner activities</b> (Trainee measures to achieve goals?)	<b>trainer activities</b> (What is the role of the trainer and what will he/she do?)	<b>forms of communication and cooperation</b>	<b>resources, tools and media</b> (What tools or media are used and how are they used?)
10 minutes	<b>Introduction and orientation</b>	- Overview of sanding techniques, tools, types of wood and occupational safety regulations for using a router.	- Participation in discussion on grinding and its importance for the carpentry trade  - Watch a video demonstrating basic sanding techniques using a router.	- Introduction to the topic and explanation of the objectives of the lesson.  - Play Video  - Allow a question and answer session to address any potential questions.	- Trainer- 2 trainees	- Projector and screen for video.  - Handouts on security guidelines
90 minutes	<b>execution of the task</b>	- Carrying out the grinding process with a router using virtual reality and VR haptics.	- Use a VR headset and VR haptic gloves to simulate the desired grinding scenario.  - Practice using the router and sanding wooden surfaces in VR and VR haptics	- VR setup and VR haptics  - Monitoring progress and ensuring VR and VR haptics are used correctly.	- Trainer- 2 trainees  The instructor provides real-time feedback on VR and VR haptics usage.	- VR glasses (e.g. Meta Quest 3)  - VR haptic gloves (e.g. bHaptics Tactgloves)  - VR router training app
20 minutes	<b>Assessment / control</b>	- Assessment of understanding and competence in using router	- Demonstration of skills in sanding a wooden surface in a controlled environment (in reality)	- Observation and evaluation of practical demonstration.  Constructive feedback and additional instructions if necessary	- (Experienced) trainee – apprentice;  - Practical demonstration.	- Grinding tools and training materials (e.g. routers).