PAINTING SKILLS ACADEMY

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Setting up a Training Innovation Lab

Preface

The guidelines provide hands-on knowledge on how to set up a Training Innovation Lab in painting trade and provide indicators on how to operate it. This guide was created especially for advising educational organisations. The learnings are also transferable to companies.

The focus is on planning and on applying modern educational technology like Augmented Reality (AR) and Virtual Reality (VR) in practical training.[1] This involves a use before, during, and after practical training phases. Access to tailor-made AR and VR content is provided.

The use and integration of these technologies requires a thoughtful application of digital pedagogy principles, which encourages especially a more self-directed and more collaborative way of training. The shift from a rather trainer-centric to learner-centric way of learning is one preferable outcome.

These guidelines focus on what to do. What works specifically for you, you must test it. Doing so will face you with challenges but also will provide you with quick wins. These guidelines will give you a head-start in setting up YOUR Training Innovation Lab safe and sound.

[1] The umbrella term is “XR” or Extended Reality.

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1. Why a training innovation lab?

A “training innovation lab” (TIL) or learning lab is aimed at inspiring and guiding teachers, trainers, and apprentices/students to implement ICT-rich education at their own school or training institute.

A “training innovation lab” is not only a physical place where painting trade teachers and trainers gain knowledge and experience about technological needs and support, but also a space to test ready-made materials like the **PSA Augmented Reality (AR)** and **Virtual Reality (VR) apps**.

a) TIL: Development plan. This plan should incorporate:
   - a *vision* (“How education can influence the world of tomorrow?”)
   - a *strategy* (“How we will achieve it”?) and
   - a *mission* (“What are your core values?”, “How do we want to deal with learners and employees?”)

Within the PSA project we define the strategy to set up a training innovation lab. This involves the following steps:

- Understand (What is known? What does fit in the mission and vision of the planning learning labs? For whom, why, what, and how learning labs are developed? (incl. educational questions)
- Explore (What scenarios and training settings are suitable? Which digital prototypes should be built and tested?)
- Materialize (What the user liked? What did they not like? What should be altered? How to bring the final product or result to more users?)

b) Decision making

Key is to make explicit choices on the professionalisation of teachers/trainers ICT skills by the management. Options are:

- Information meetings,
- Short courses and trainings,
- Coaching and peer review,
- Participation in a network and
- External trainings.

c) Professionalisation of teachers/trainers

Figure 1: Flow chart professionalisation of teaching personal in 3 steps

d) Content development for trainings

The enrichment of existing trainings with modern digital media is aimed. Key is the description of the specific educational problem or challenge where the new technology can help with.

The software programming of an interactive room or object (= digital twin) would make sense for training scarce, expensive, or dangerous tasks. This would be the case e. g. to handle an airless or applying expensive paints on different undergrounds. For ensuring real-time support of rather standard tasks no programming solutions are preferable, like live or remote support.

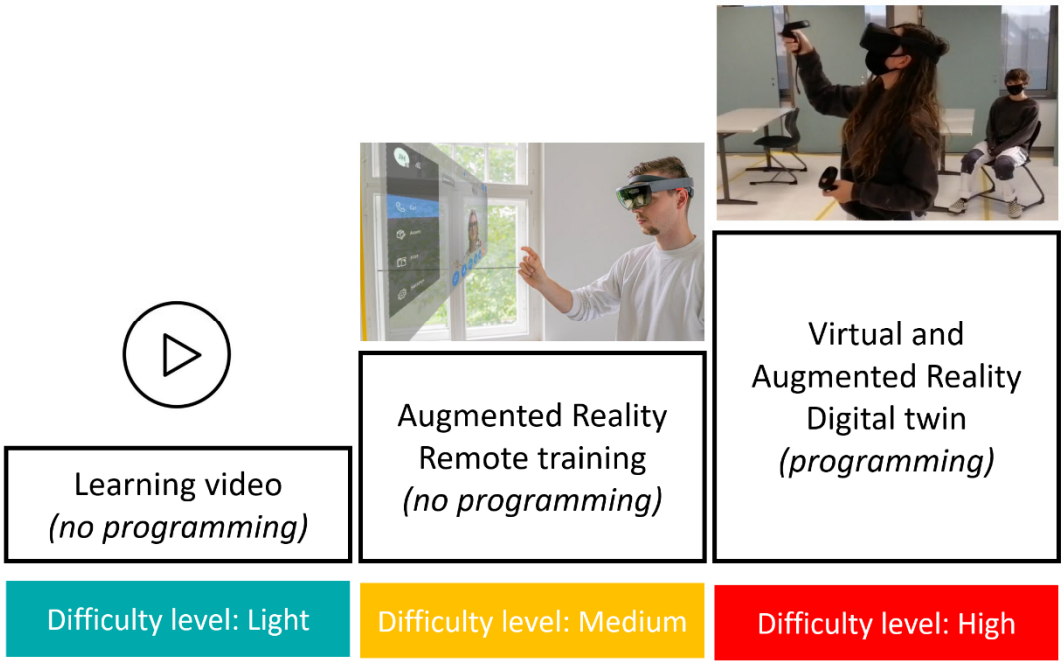


Figure 2: Difficulty levels of creating digital media: video, AR, and VR programming's

2. What is needed?

Augmented and Virtual technology are already companions of our daily live. Think of selecting virtual furniture for your room by using the “IKEA Place” AR app before buying the real piece.

Augmented Reality is the enrichment of the visible reality with computer generated, interactive holograms for guidance and explanation of non-visible processes. To see holograms, specialised technology, like smart glasses (AR glasses), smartphones or tablets are necessary. The use of smart glasses allows a hands-free training.

Virtual Reality is the complete immersion in a computer generated, interactive environment. Therefore, special hardware like smart glasses (VR glasses) are necessary.

Decisive factors for buying AR and VR smart glasses are:

- Field of view (AR)
- Control options
- Refresh rate (for visualisation stability and latency)
- Weight
- Battery duration
- Operating System
- Price
- Perceived easiness to create and use own or tailor-made training content

Suitable glasses for training:

Figure 4. Microsoft HoloLens (AR glass)

Figure 5. Meta Quest 2 (VR glass)

AR - Remote support (Remote Training): Is the audio-visual guidance of the expert to the learner, who wears the AR glasses (e. g. Microsoft HoloLens 2). The expert, a trainer or an experienced professional can say look on left side of a painted wall and annotate that part of the wall with a digital generated hologram in the shape of an arrow. The required hard- and software involve:

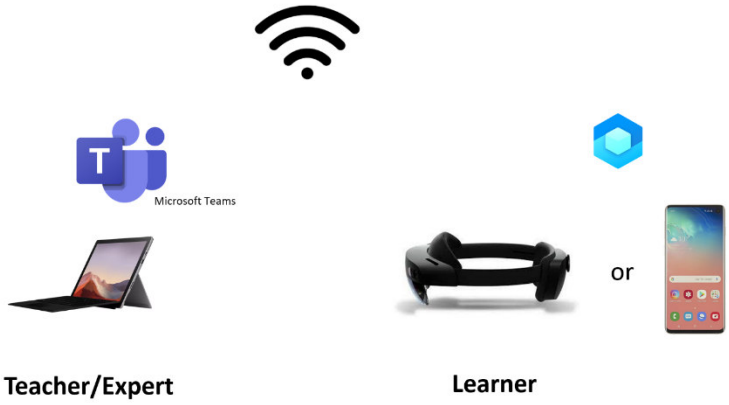


Figure 6. AR Remote training requirements (no software programming needed)

AR and VR Digital Twins: Interactive digital twins (“digital 3D representations”) of objects or areas enable painters to virtually interact with e. g. an digital model of an Airless or a room. The relevant hard- and software needed are AR or VR glasses and the relevant app:

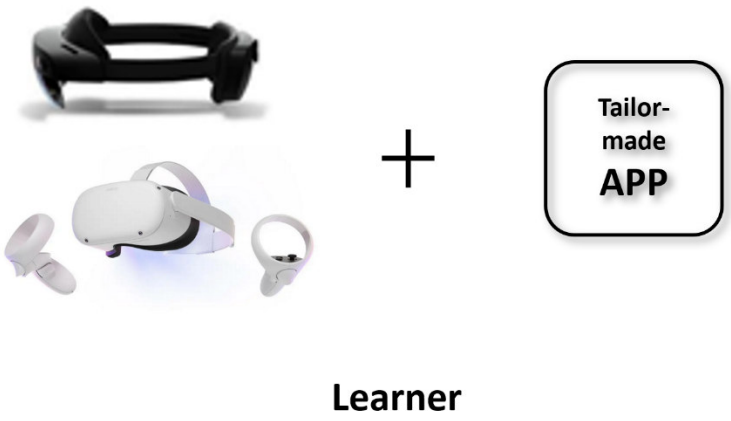


Figure 7. Augmented Reality and Virtual Reality Digital Twin technology needs

To easily overcome technical limitations in training please see **APPENDIX 1**.

3. How to use modern technology for practical training?

Modern technology is not a must-have, but it can be if applied correctly. Modern technology includes e. g. tablets, smart screens for rather theoretical knowledge provision as well as hard- and software like smart glasses (AR and VR) for a use in practical training.

The application requires knowledge about the set-up costs and time as well as applying it for the right tasks. A rule of thumb with AR and VR is if it is better showed and experienced in a safe environment several times again, then these both technologies are the choice. To do this safe and sound, the following subsequent steps are recommended:

The **first step** is always to define the educational problem. This means, technology is used as a tool to reach one or more learning goals. It is expected that the modern technology does this more efficient than existing technologies.

In a **second step** the learning goals are framed towards modern technology, e. g. by using a hierarchy of learning goals (Blooms taxonomy). The use of AR and VR are rather suitable for experiencing things (hierarchy level: high), rather than simple a knowledge provision (hierarchy level: low).

Figure 3: Hierarchy of learning goals (Blooms taxonomy)

In a **third step** the way of knowledge or skills provision should be determined. This could reach e. g. from a trainer centred approach to a more learner centred approach, e. g. by supporting self-directed learning options for rather good learners.

In a **fourth step** the evaluation format and criteria are defined. (**APPENDIX 2**)

To get a sound AR and VR use, the following **PSA use cases or learning scenarios**[2] are presented. This included the four steps approach, which is explained above.

I. AUGMENTED REALITY: Live support during to access wall paint (DURING PROCESS)

STEP 1: Expert or trainer is not in the room. (Educational problem)

STEP 2: With the help of the remote trainer the apprentice can assess the wall paint. (Learning goal)

STEP 3: Trainer-apprentice (1:1), live by using AR glasses Microsoft HoloLens 1 or 2 and the Remote Assist App to provide audio-visual instruction (Communication form)

STEP 4: Assessment in real-time by view by the remote trainer.

[2] It describes what learners should do with support of the trainer, the technologies available and the possible learning forms.

Requirements: WIFI, AR-Glasses, Remote Assist App

PSA test results: easy to use (AR glasses and Software) and suitable for real-time guidance.

SCAN ME

(Access to learning video)

II. AUGMENTED REALITY: Learn to start an Airless (BEFORE PROCESS)

STEP 1: Safety risk for apprentices is too high to learn in a time-efficient way to start the high pressure Airless without trainer guidance on a construction site. (Educational problem)

STEP 2: The apprentice can carry out successfully the start of the Airless. (Learning goal)

STEP 3: Self-instructed step-by-step digital twin by using the AR glasses Microsoft HoloLens 2 and a tailor-made App, which runs on the HoloLens. (Communication form)

STEP 4: Assessment is done by successful completion of subsequent steps of AR digital twin (and by starting a real Airless afterwards on a construction site)

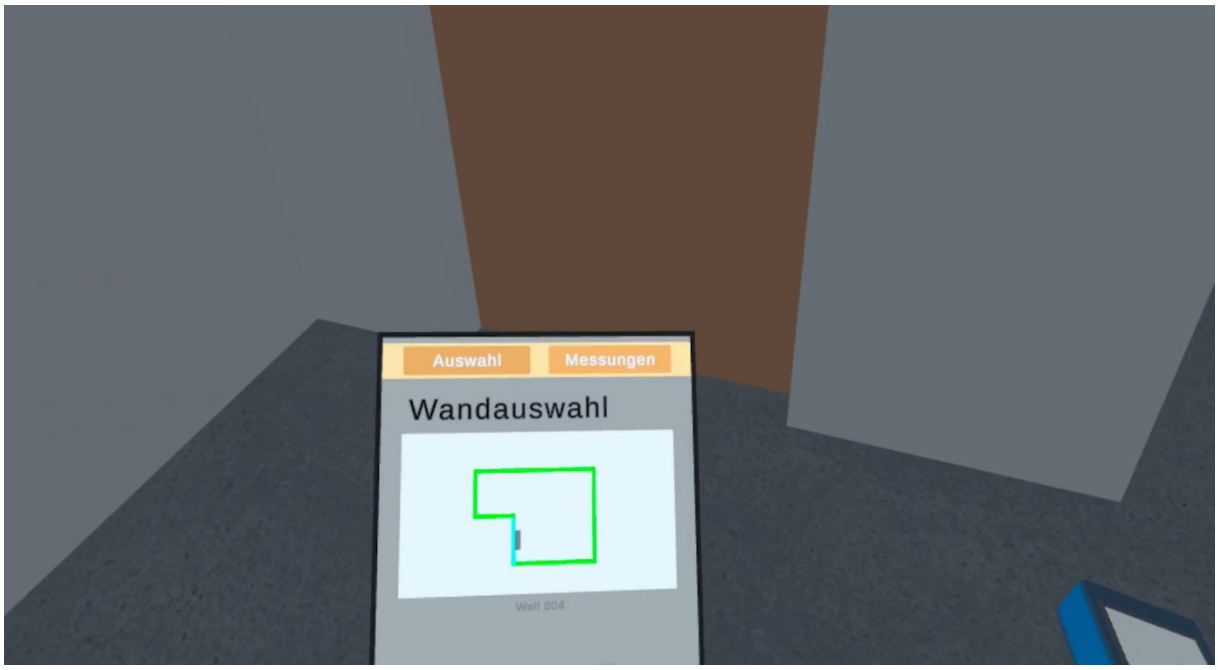
Requirements: AR-Glasses, Airless App

PSA test results: Hard- and Software was easy to use, step-by-step guidance suitable, transfer of knowledge afterwards in practical training rated as “rather much”

SCAN ME

(Access to learning video)

III. VIRTUAL REALITY: VR Measurement of a room (BEFORE PROCESS)



Step 1: Apprentices have problems to measure a room correctly even when tried multiple times. (Educational problem)

Step 2: Apprentices should be able to carry out room measurement correctly in a self-directed way. (Learning goal)

Step 3: VR measurement is carried out in a self-directed manner. (Communication form)

Step 4: The assessment of the performance is done by obtaining the correct results (feedback app).

Requirements: VR-Glasses, VR measurement App

PSA test results: Hard- and Software was easy to use, and apprentices gained episodic memory, which enables a better transfer into training practice afterwards.

SCAN ME

(Access to learning video)

For a detailed scenario planning please check **APPENDIX 3**. More information on the lessons learned from using AR and VR hard- and software for painters' training are available in **APPENDIX 4**.

4. Outlook: How to operate a learning lab?

Three core parameters are important:

Organisation:

The learning lab should serve a purpose as a place to be to “seduce” trainers to get them in touch with new technology and innovative learning approaches. A suitable option is a physical place to experiment with AR and VR, to develop pedagogical-sound scenarios, and share best practices.

The continuous support from the organisations management is necessary. This can be achieved when the learning lab contributes to the strategic agenda of the organisation. For educational organisations staff training could be the primary motive. For companies a potential testbed is the presentation of modern educational technology use on career fairs to attract personnel, to foster time-efficient, professional knowledge and skills provision, before, during and after working on a construction site.

Financing:

Modern technologies require not only money but also relevant time resources to try out and experiment. When applied today, in the mid-term money will be saved e.g. by more efficient training procedures. Therefore, the investment will pay off in a certain timeframe.

In addition, to lower financial risks and reduce potential concerns, the start with solutions where no programming is needed is key (AR Remote Assist). For more complex tasks financing is provided by national or EU funds for innovation and piloting projects. National chamber of crafts, branch and research organisation always looking for piloting partners.

The reduce the costs further, networking with experienced organisation in the region or branch is suitable. In addition, hands-on and tips gained from this organisation by just asking them or approach them with your questions, during public events will provide valuable insights on what is really needed and what is not for your specific situation.

The investment in technology can be also seen as part of the companies or organisation marketing budget.

Teachers/Trainers:

Key is to start to innovate with existing technologies and market the learning lab as the place, where trainers get suitable equipment as well technical and pedagogical support. This could reach from getting explained how the start an AR glass and how to use it correctly in training. This problem-solving approach will result in more requests from in- and outside the organisation, as word-of-mouth spreads fast.

5. Checklist: Ready to start and level up?

This brief checklist will help you to assess your state and your needs to start and operate a learning lab. Below you will find access to the tailor-made AR and VR apps created for the PSA project.

A) ROOKIE

- ☐ Frequency: First or on-time use (small companies or organisations)
- ☐ Hard- and Software: Learning videos and rented Microsoft HoloLens + Remote Assist App
- ☐ Use case/learning scenario: Real-time support of e. g. painting a wall by using AR glasses and ready-made app
- ☐ Assessment: Set-up times, time savings, quality of work, monitoring period: 0,5 - 1 year

B) SOME EXPERIENCE

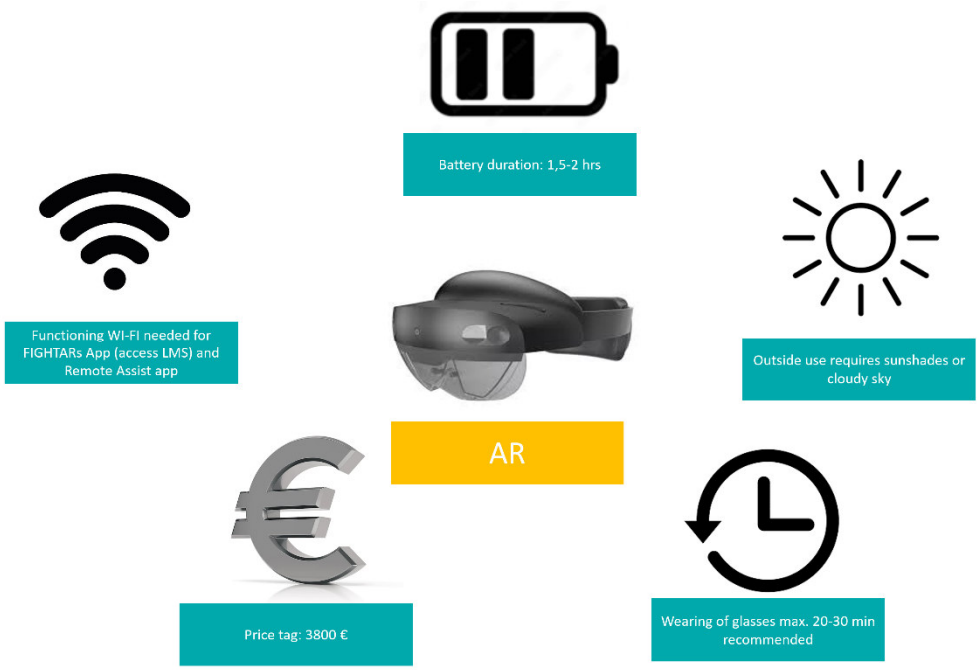
- ☐ Frequency: two to five times (small- and medium sized companies or organisations)
- ☐ Hard- and Software: Learning videos, AR glasses like Microsoft HoloLens 2, Remote Assist App and Airless App as well as VR glasses like Meta Quest 2, VR measurement app
- ☐ Use case/learning scenario: Real-time support with Remote Assist app, upfront training with AR (Airless) and VR (measurement), planning further low threshold scenarios with AR remote assist and switch e. g. from teacher-centred to peer learning
- ☐ Assessment: time savings, number of trainers trained inside the organisation, quality improvement in work execution after trainings, monitoring period: min. 1 year

C) EXPERT

- ☐ Frequency: multiple times, continuous offers (larger organisation)
- ☐ Hard- and Software: sets of AR and VR glasses with relevant ready-made and tailor-made Apps
- ☐ Use case/learning scenario: AR and VR scenarios (real-time, remote, teacher-centred, learner-centred etc.) in painting trade and beyond
- ☐ Assessment: number of trainers trained in- and outside the organisation, quality improvement in work execution after trainings, turnover generated by trainings, monitoring period: on a regularly basis

APPENDICES

APPENDIX 1: Limitations of AR and VR glass use and ways to overcome them



Possible solutions:

Battery duration: have cable extension with you for charging (in pause mode or also during operation if it does not hinder the using)

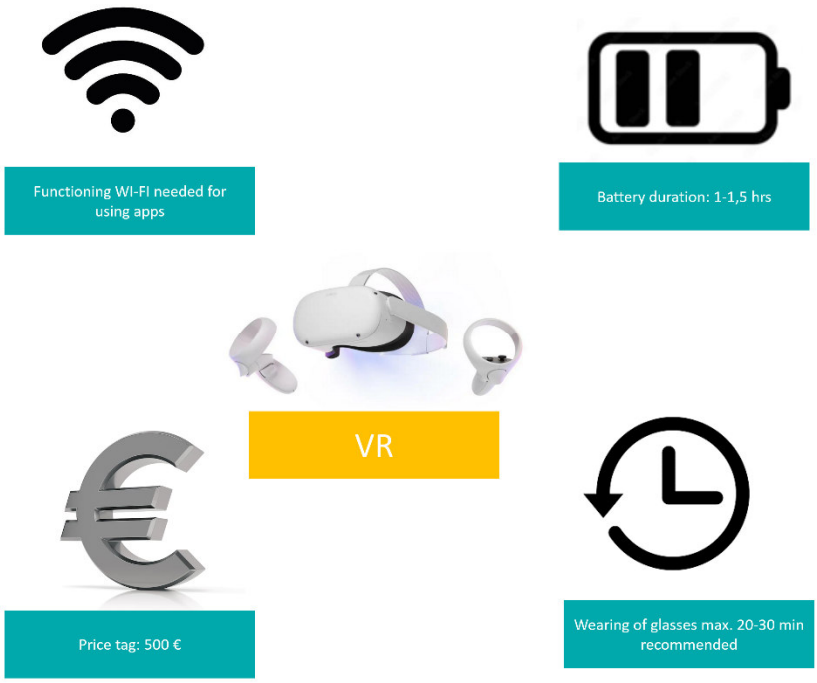
Sun: It is possible to have sunshades for the HoloLens 2 ("HoloTint")[3]. There is also modification of the HoloLens 2 for a use with a safety helmet (Trimble HoloLens 2)

Wi-Fi: A training ground with poor Wi-Fi prevents the use of the Remote Assist App.

Duration: More training with the HoloLens 2 will result in longer usage times.

Price tag: Buy a used HoloLens 2 or wait for further AR glasses. If you are only interested in the remote assist function, you can also buy a Vuzix smart glass (lie Vuzix Blade). The price tag is around 1000 €.

[3] https://www.microsoft.com/en-us/d/trimble-holotint/94bvb2zp0vsf (04.10.2022)



Possible solutions:

Battery duration: have cable extension with you for charging (in pause mode or also during operation if it does not hinder the using)

Wi-Fi: A training ground with poor Wi-Fi prevents the use of the VR apps.

Duration: More training with the Meta Quest 2 will result in longer usage times.

Price tag: Buy a used Meta Quest 2.

APPENDIX 2: Evaluation

SELF-ASSESSMENT

Scaled questions (suggest 5-point scale).

Question	Yes/Very much/ A lot				No/ Not at all
Did you find the session/course well organised and structured?					
Did you find the process straightforward to follow?					
Do you feel that your understanding of the topic has increased?					
How satisfied are you with your performance of the tasks?					
How confident are you that you can use what you have learned at work/in an independent project?					
Did you find it easy to recover from mistakes or misunderstandings?					
Did you find it easy to get answers to any questions you had?					
Was the technology (AR, 360° video) comfortable to use?					
Was it easy to find your way around the technology?					

Was it easy to move from one step to the next using the technology?					
Did you feel that the technology helped you learn?					
…					

OBSERVATION

This template is for multiple learners for one major activity or task.

Activity													
Observer													
Name	**Qs**	**Help**	**Step 1**		**Step 2**		**Step 3**		**Step 4**		**Total**		**Level**
			Time	Err	Time	Err	Time	Err	Time	Err	Time	Err	

Note on columns:

- Questions – these are questions seeking to clarify process, get feedback etc. Ignore 'interest' questions e. g. asking for more advanced knowledge.
- Help – where the learner is stuck and needs the trainer's help to move on.
- Time – to complete the step.
- Errors – number of obvious errors at end of step.
- (If there are no clear breaks in the process, ignore the intermediate steps).
- Level – decide on a scale e. g. 1-5 each with clear criteria (e.g. novice-to-expert definitions, see end of document).

Comments:

Add your comments e. g. about learners' engagement and 'flow', and for technology-mediated groups their ease of use of the technology.

APPENDIX 3: Scenario planning template

SCENARIO		(THEORETICAL OR PRACTICAL TRAINING)

LEARNING CONTENT PHASE	WORKING STEPS (LEARNING ACTIVITIES)	TECHNOLOGY	COMMUNICATION & COLLABORATION	TEACHER ACTIVITIES
Analysis/Orientation (xx min)				
Execution (xx min)				
Assessment (xx min)				

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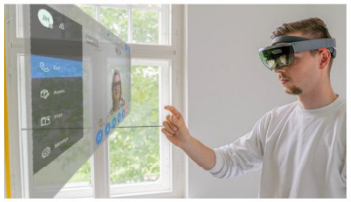
APPENDIX 4: Lessons learned from testing AR and VR app

AR: Remote Assist



- In- and outdoor use
- Functioning Wifi
- Procedural tasks
- Integration of holograms – user slow head move

AR: Airless

- Rather indoor use
- Pinning of model in space needed
- Button etc. selection requires upfront training

VR: Measurement

- Indoor use only
- Provision of the basic principles of room measurement
- VR-Controller training recommended

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YouTube

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