

1 Focusgroup 25.02.2020

2 Abridged transcript based on notes and a recording of the focus group interview.

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4 **Tell us your names and for how long you have been working in radiographic imaging.**

5 Participant 1 (P1): Radiographer since 2012 / Lecturer since 2017 (8 and 3 years)

6 Participant 2 (P2): Radiographer since 1999 / Lecturer since 2007 (21 and 13 years)

7 Participant 3 (P3): Radiographer since 2012 / Lecturer since 2017 (8 and 3 years)

8 Participant 4 (P4): Radiographer since 2011 / Lecturer since 2016 (9 and 4 years)

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10 **Think back on how you trained radiographic positioning, what were your impression**
11 **on the teaching methods?**

12 P1 and P3: **Theoretical input** via lectures, supported by PowerPoint presentations. **Practical role-play**
13 **exercises in a laboratory setting** in groups of 10 to 15 students and a **trainer** on a radiography system.
14 The laboratory was only accessible with a trainer during planned training lessons.

15 P4: **Theoretical input** via lectures, supported by textbooks. **Practical role-play and phantom exercises**
16 **in a laboratory setting** in groups of five people and a **trainer** on a radiography system. The laboratory
17 was only accessible with a trainer during planned training lessons.

18 P2: **Theoretical input** via lectures, supported by textbooks. **Practical role-play and phantom exercises**
19 **in a laboratory setting** in groups of five people and a **trainer** on a radiography system. Additionally,
20 open access to radiography system for self-study with peers.

21 **Which would be the optimal setting for practical training of radiographic positioning?**

22 P3: **Role play exercises** in a laboratory setting with additional **open access** to radiography systems for
23 groups of three to five people, to enable **self-study**.

24 P4: **Five students are the maximum**, including a trainer the space in a laboratory is already limited.

25 P1: **Six students** could be given different exercised. Two could prepare for the exercise, two could do
26 the exercise and two could evaluate the results of the exercise.

27 P2: To learn all parameters of a radiographic procedure, **practise and repetition** are important. To
28 allow for repetition, **open access** to a radiography system, which allows students to exercise according
29 to their **own schedule**, would be optimal.

30 **How do you think augmented reality (AR) could improve the training of radiographic positioning?**

31 P1: New and innovative tools **promote** students' **interest and engagement**.

32 P4: New and innovative tools **increase** students' **motivation to learn**. Practical exercises certainly have
33 the highest learning effect, AR is the next best method to practice and in a **more resource-saving** way.
34 With targeted preparation using AR tools, real role play exercises can be carried out more efficiently.

35 P1: AR could be used in a flipped-classroom setting. Students could **practise according to their own**
36 **schedule** and **without supervision**. Which would have them **better prepared for the supervised role-**
37 **play exercises in the laboratory**.

38 P2: AR tools guarantee **reproducible exercise conditions**.

39 P4: AR allows students to **exercise without any pressure and risks for patients**. Which enables
40 students to **exercise without pressure** and in their own **comfortable speed**.

41 P2: AR applications could **track the students' learning progress** and **test their knowledge** with tests.

42 P4: The educational content could be adapted to the **students' learning progress** and give access to

43 new content only after completion of certain topics.

44 **How would you like to receive assistance in radiographic positioning from an AR device?**

45 P4: In addition to visual data, speech output could also be used to convey information. Ideally only if

46 activated by the user.

47 P3: Speech input could be utilized to trigger audio explanations

48 P1: All speech output should additionally be visualized in text form.

49 P4: A speech interface with speech output could support people with disabilities in using the tool.

50 P3: Communicating information in audio and text format can be beneficial for different learning types.

51 **Which additional visual aids, other than the position of the body part would be useful?**

52 P4: Central beam, collimation, detector size, exposition parameters, the resulting x-ray image

53 P1: Angle and position of the x-ray tube, if the test patients' body part is positioned correctly.

54 P3: Information about the detector size, if the detector is placed inside the x-ray table and therefore

55 not visible. Necessary radiation protection measures.

56 P2: Holograms of patients with pathologies or traumas, which cannot be trained in a laboratory role-

57 play exercise.

58 P3: Information about patient preparation: If jewellery, items of clothing or dental prosthesis have to

59 be removed. Maybe in text or audio format before the exercise is started.

60 P4: The application should also not be overloaded with features.

61 **How important is the visual quality (realism) of the visual aid provided by the AR Headset?**

62 P4: Very important, distinctive anatomical structures must be visible. To simplistic models without a

63 texture could lessen the immersion and the engagement of the students.

64 P3: Central beam and collimation are determined using anatomical structures, it is important to

65 recognize these structures on the holograms.

66 P2: If holograms are too complex and have too many details, they could distract from the main goals of

67 the exercise. Models featuring pathologies or traumas, or patients of different ethnicity could increase

68 the learning effect.

69 **How would you want to interact with the holograms?**

70 P4: Holograms should be positioned in the room with hand gestures, like smartphone interaction.

71 P2: Speech input would be convenient. Using hand gestures could add immersion and increase the

72 learning effect.

73 P1: Interaction with holograms via hand gestures like smartphones would ease the handling.

74 P3: Complex interaction with holograms using speech input could be difficult to realise and use.

75 Changes of a few millimetres or degrees could be hard to realise utilizing speech input. Internalizing

76 movements while learning could also increase the learning effect.

77 **How would you like to receive feedback for your inputs?**

78 P4: Haptic feedback through a vibrating AR headset.

79 P3: Through optical feedback, constant audio feedback could be irritating.

80 P4: Specific audio feedback for certain interactions can make interaction with holograms easier.

81 P1: To much audio feedback can get annoying, audio feedback should be an option.

82 P3: Users should be able to enable or disable audio feedback.

83 **How could real life radiographic equipment be included in the AR training sessions?**

84 P1: Radiographic equipment enables practical role play training. An AR application does not add a lot
85 of value if a radiography system is available. AR can be used in preparation for real life exercises or as
86 an additional offer.

87 P4: AR in addition to a real radiography system could be too much information at the same time. A
88 field of view with real equipment, role play partners and holograms visible, could overwhelm the
89 users. The light beam collimator could also affect the projection of the holograms.

90 P2: A possible application of AR in combination with a radiography system could be the support in
91 patient positioning in a clinical setting.

92 P3: AR holograms could support with the positioning of patients for positions where the position of
93 the detector is not visible for the user.

94 **Resources/costs:**

95 P4: This approach is only feasible if the laboratory is spacious enough to enable undisturbed training
96 for all groups.

97 P1: For university programmes with large amounts of students, splitting students in groups of five will
98 need additional resources, like trainers and laboratories.

99 P3: The initial purchase cost for enough hardware must be considered.

100 P4: Possible wear and tear of mishandled rental hardware could also be an issue. Additionally, training
101 all students on using the AR hardware needs additional resourcesP2: The HoloLens is, compared to
102 radiography systems or dedicated simulators like the VERT system, rather cheap to purchase.

103 P4: With ongoing technical progress, AR hardware will get cheaper and more accessible.

104 P1: To justify the cost of purchase for an AR system, the possibility of using the technology for other
105 lectures should be explored.

106

107 **Outlook:**

108 **P2: Localizing the application to different languages would enlarge the pool of possible users.**

109 Maybe a two-dimensional browser-based variant of the tool could be realised. Which would enable
110 real time and space independent learning.

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