Mixed Reality in medical Education based on Interactive Applications (MIREIA)

Reference: 621668-EPP-1-2020-1-ES-EPPKA2-KA

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GR21201, TA18023

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Co-funded by the Erasmus+ Programme of the European Union

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Background

Medical education

- Long and demanding process
- Requiring the learning of extensive theoretical knowledge as well as a set of technical and non-technical skills.

Formative methods

- ***Traditional***: Based on static learning content and sometimes far from actual clinical practice.
- ***State of art***: Based on the use of information and communication technologies (ICTs): Extended reality (XR) technologies (VR, AR, MR) and three-dimensional (3D) printing.

Challenges

1. There are no technologies for the rapid and automatic generation of 3D models for training purposes in medicine.

   Therefore, models must be obtained from third parties with limited customization.

2. There are no accepted standards for exploiting these novel immersive (VR/MR) and 3D printing technologies with methodological guidelines in medical training.

3. Proved evidence to support the validity of personalized models based on MR and 3D printing technologies as learning and training tools.

What is MIREIA?

MIREIA

MIREIA is a unique Knowledge Alliance involving **Higher Education institutions (HEIs), research institutions and companies** that will combine the use of cutting-edge technology in immersive virtual technology (VR, AR, MR) and 3D printing with personalized learning content to promote the student-centred learning process of medical students and residents in minimally invasive surgery (MIS).

Tools to be provided for medical education

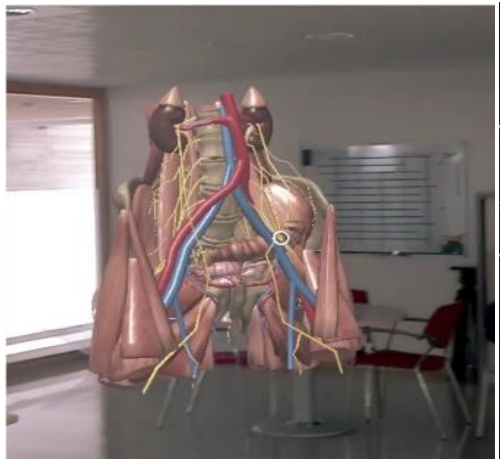
1. Extended reality (VR, AR, MR) and 3D printing models

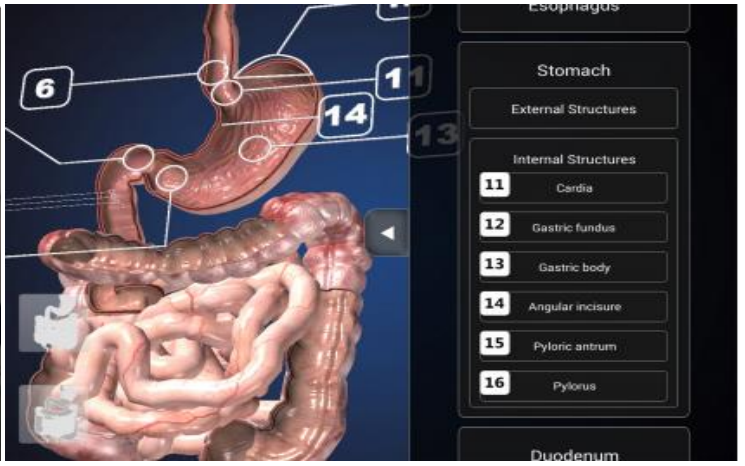
   Medical education and training of technical and non-technical surgical skills

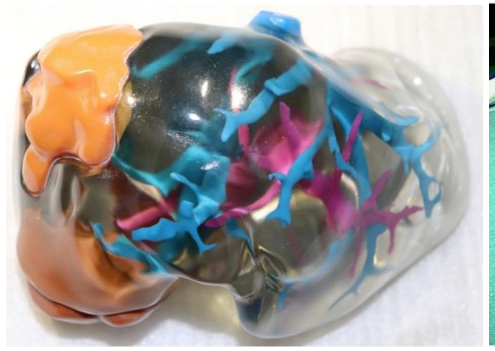
2. Tools for semi-automatic creation of anatomical 3D models

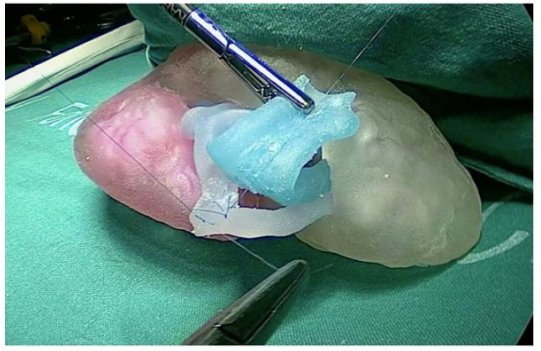
3. Tools for creation of personalized virtual training environments

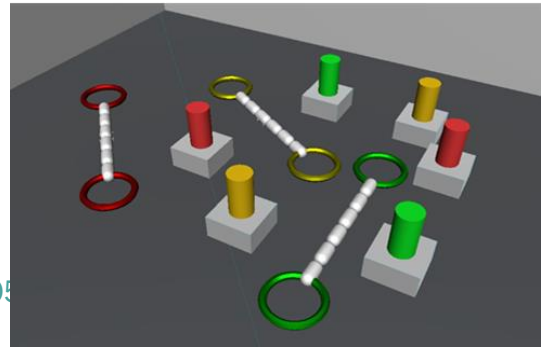
4. Open access online content repository

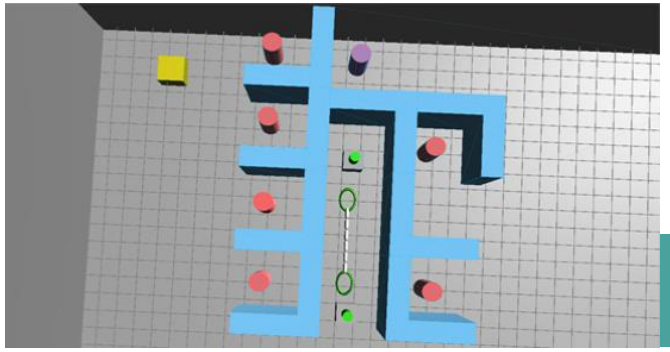








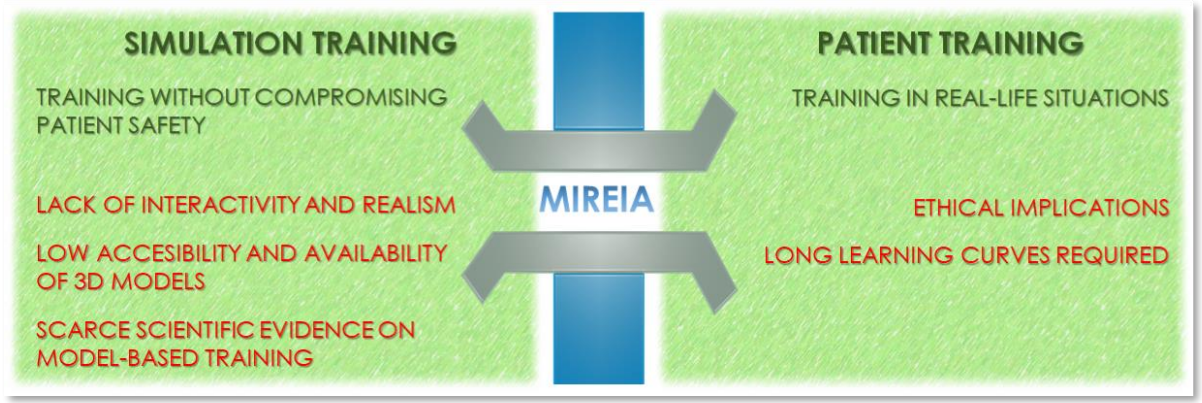


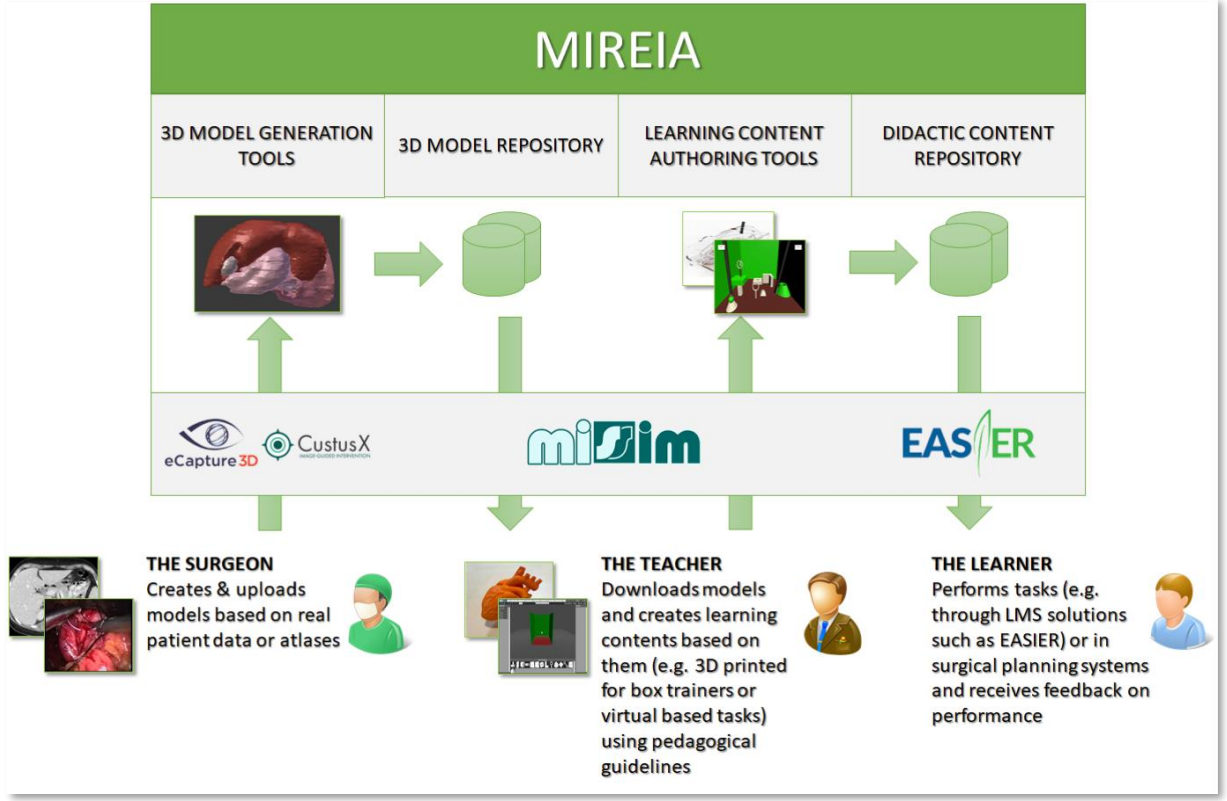


MIREIA
Co-funded by the Erasmus+ Programme of the European Union

What are our goals?

- To bridge the gap between classroom learning and laboratory training and actual clinical practice.
- To provide an innovative methodology incorporating tools and guidelines to support the early stages of medical training and MIS education through learning content based on immersive technologies (VR, AR and MR) and 3D printing.





Project consortium

Project consortium

Centro de Cirugía de Mínima Invasión
Minimally Invasive Surgery Centre
Jesús Usón

Cáceres (Spain). Project Coordinator.
More than 20 years of experience in surgical training and surgical research.

POLITÉCNICA

Madrid (Spain). Scientific coordinator.
Experience in technology enhancement learning (TEL) for healthcare education.

TU Delft

Delft (The Netherlands). Quality actions and pedagogical needs leader.
One of the most important European research groups in TEL applied to medicine and surgery.

SINTEF

Trondheim (Norway). Learning content creation leader.
Scandinavia's largest independent research organisation dedicated to creating innovative technological solutions.

Project consortium

Badajoz (Spain). Exploitation leader.
Experience in the development of 3D digitization and 3D modelling technologies.

Oslo (Norway). Implementation leader.
They focus their research on the development and use of new technologies for surgical support.

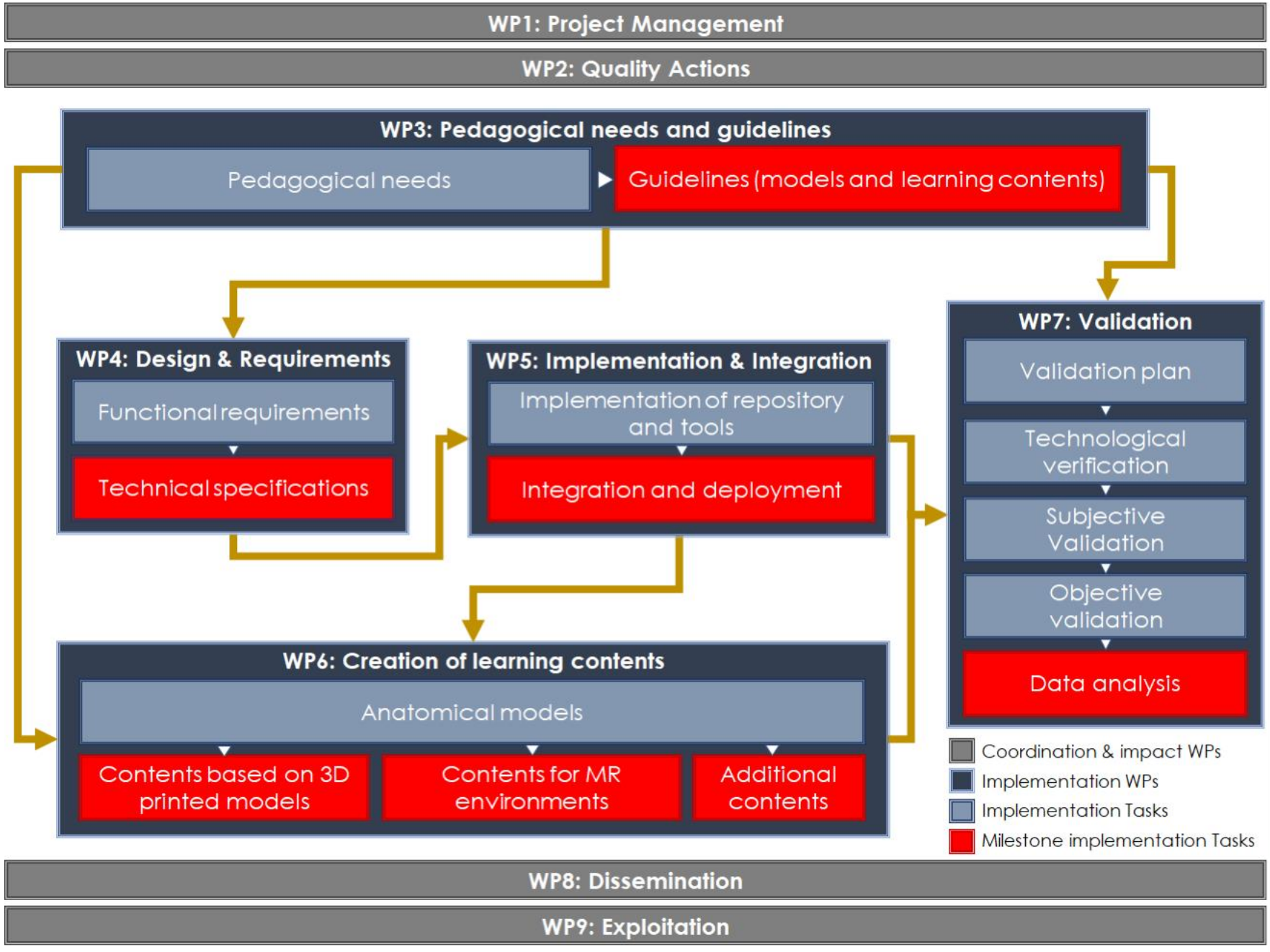
Athens (Greece). Content repository leader.
Extensive knowledge of web platforms, large data implementations, and data engineering and storage systems.

Project consortium

Câmpina (Romania). Dissemination leader.
Surgical partner with direct access to a wide network of surgeons across Europe for dissemination and validation activities.

Trondheim (Norway). Creating learning content and validation.
University Hospital for Mid-Norway and integrated with NTNU (Norwegian University of Science and Technology).

Work packages


WP1: Project Management
WP2: Quality Actions
WP3: Pedagogical needs and guidelines
Pedagogical needs
Guidelines (models and learning contents)
WP4: Design & Requirements
Functional requirements
Technical specifications
WP5: Implementation & Integration
Implementation of repository and tools
Integration and deployment
WP7: Validation
Validation plan
Technological verification
Subjective Validation
Objective validation
Data analysis
WP6: Creation of learning contents
Anatomical models
Contents based on 3D printed models
Contents for MR environments
Additional contents
Coordination & impact WPs
Implementation WPs
Implementation Tasks
Milestone implementation Tasks
WP8: Dissemination
WP9: Exploitation

Current status

Pedagogical needs and guidelines → **Design requirements** → **Implementation and integration** → **Creation of learning content** → **Validation**

- Content repository
- Tools implementation
- Integration

- Anatomical models
- Virtual MIS training
- 3D-printing models
- Additional material

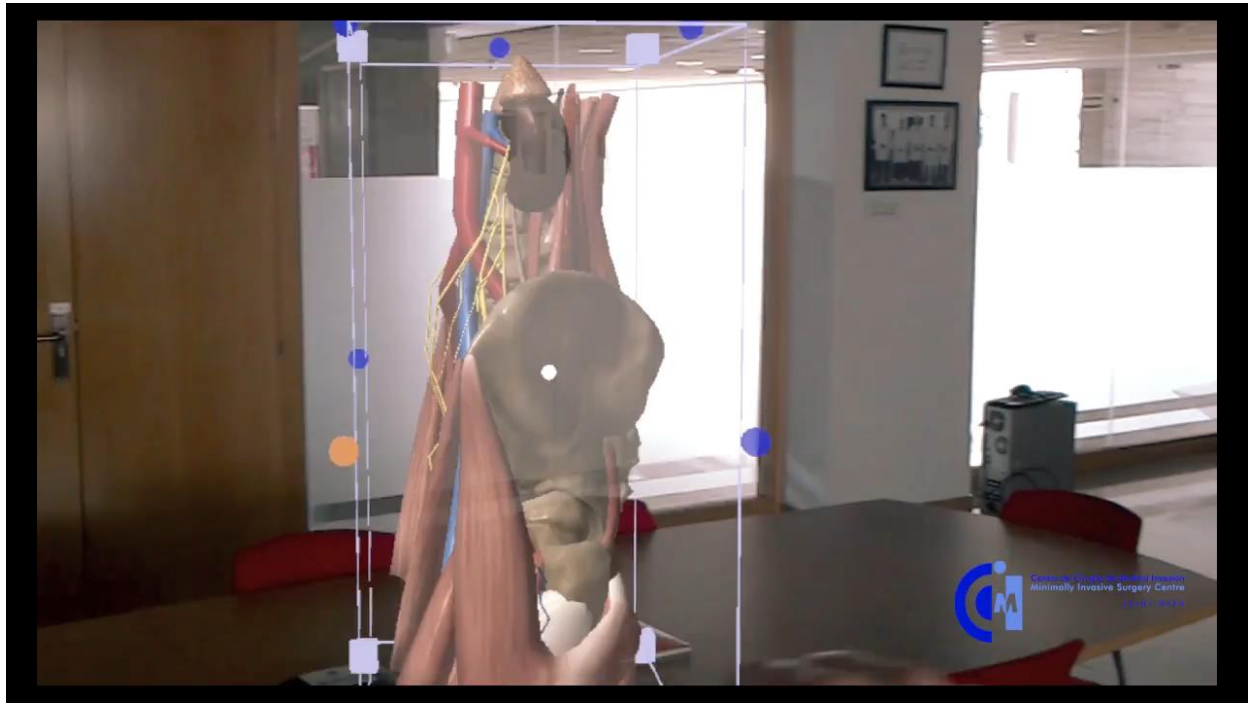
- Technical
- Subjective
- Objective

Examples of learning material

Pelvis model
CCMIJU

Mixed Reality techniques

- Muscular, vascular, bone and nervous systems
- Completely interactive: Move, rotate, scale
- Information for each individual anatomical structure



Colon model
CCMIJU & MEDIS

Objective

To provide different tools for enhancing the diagnosis of colon lesions and providing an interactive model for surgical training.

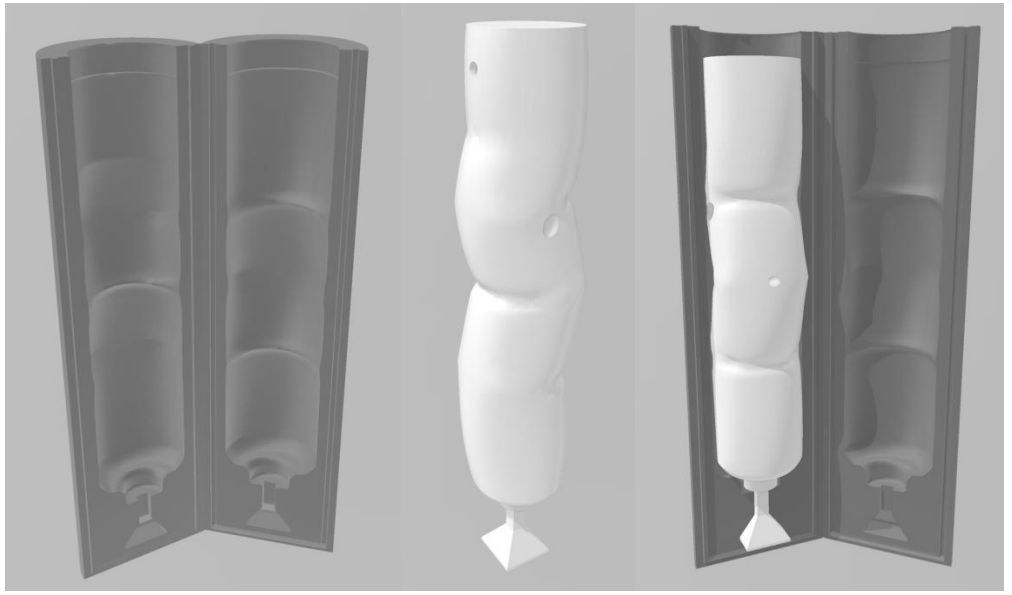
Models

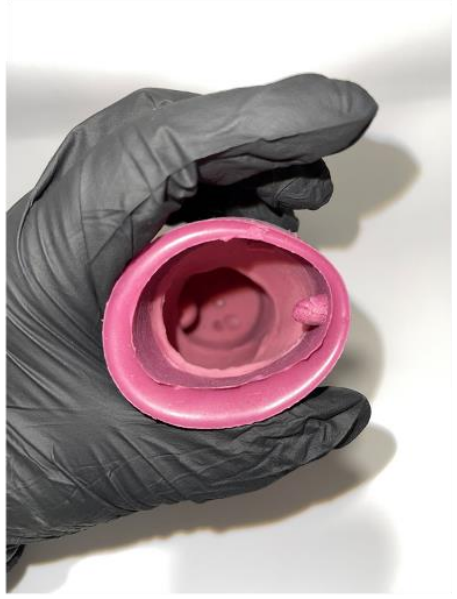
- 3D-printed model
- 3D navigation (augmented reality)

Colon model
CCMIJU & MEDIS

3D printing + moulding techniques

1. Design of the colon moulds
   - A wrap
   - 2 sizes of colon moulds: inner and external layer
   - Personalized lesions (polyps)
2. 3D printing
3. 2-steps silicone filling
   - Mucosa layer (including lesions)
   - Muscular layer



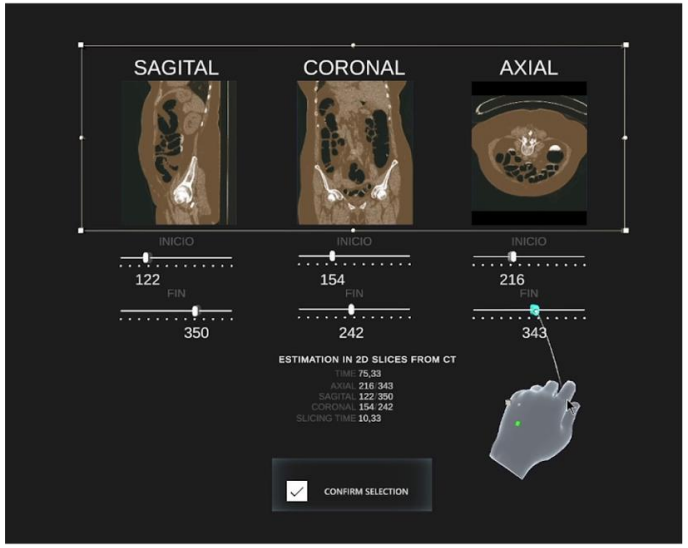


Colon model
CCMIJU & MEDIS

Mixed Reality techniques

Training scenes:

1. Lesion identification in CT views (sagittal, coronal and axial)
2. Lesion identification in a 3D virtual model



Colon model
Validation at CMIJU

Participants (n = 32)

Medical students, residents and surgeons

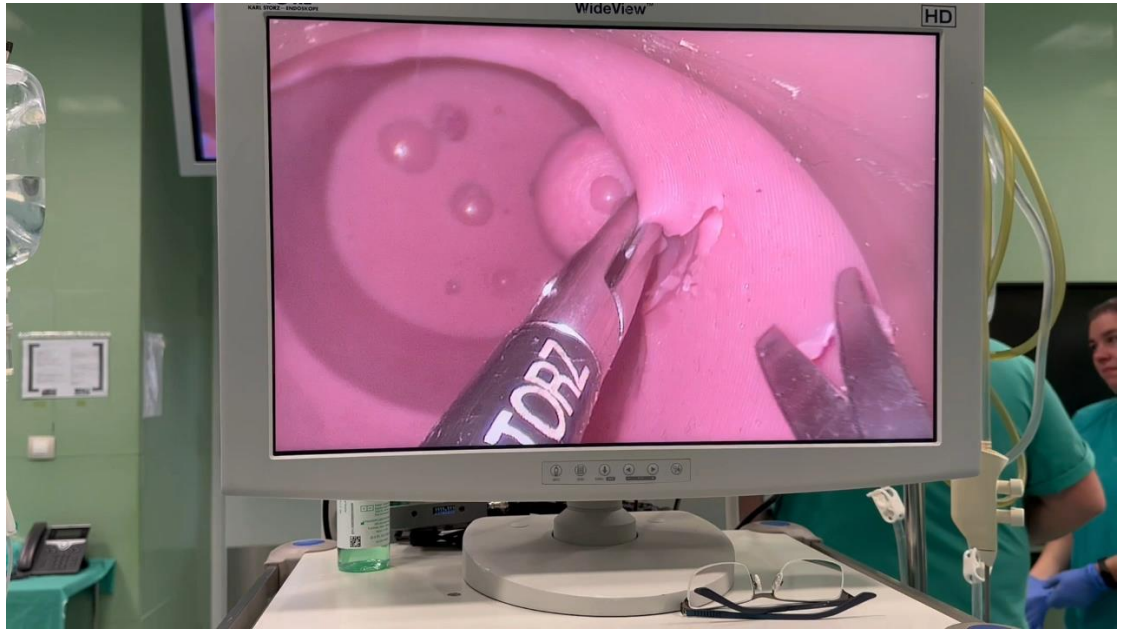
3D printing + moulding techniques

- Appearance and usability

Colon model
Validation at CMIJU

3D printing + moulding techniques

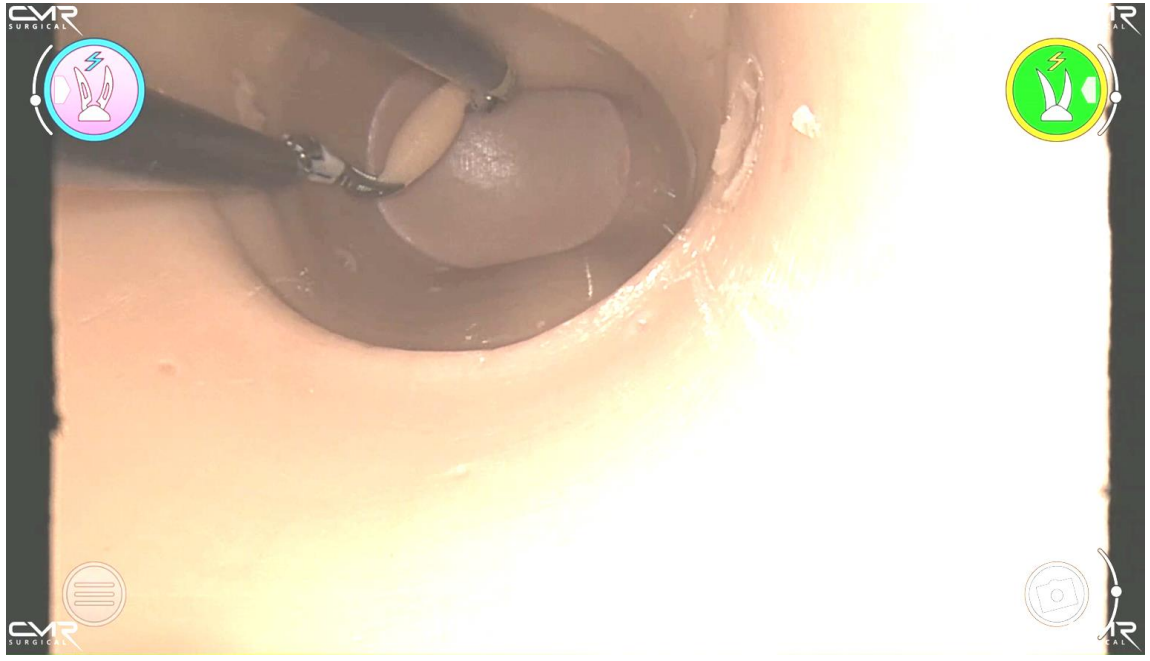
- Training in transanal surgery



Colon model
Validation at CMIJU

3D printing + moulding techniques

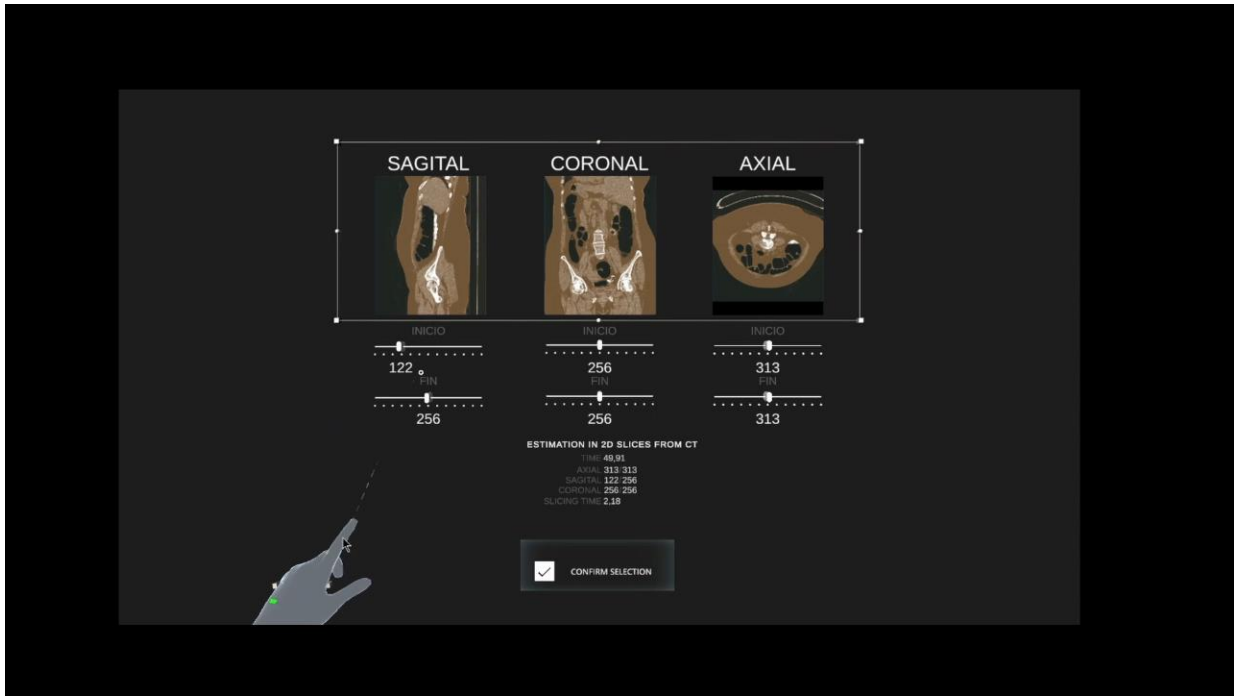
- Training in robotic-assisted transanal surgery



Colon model
Validation at CMIJU

Mixed Reality technologies

- Subjective and objective validation



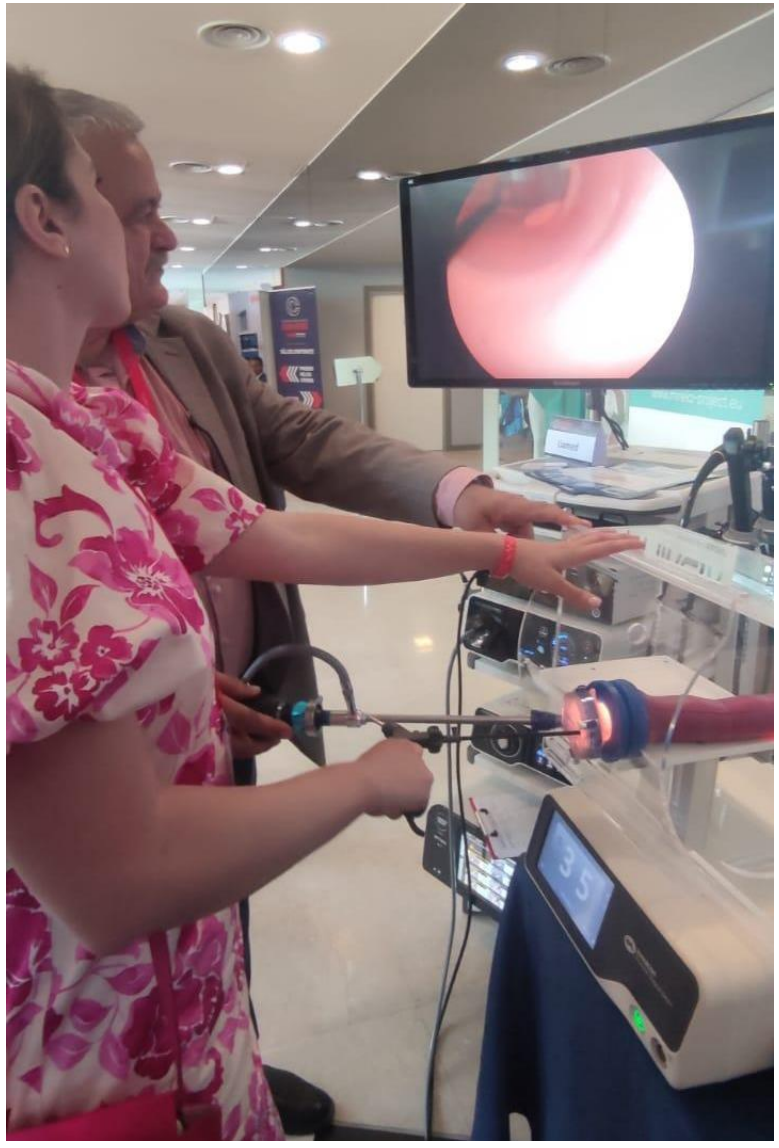
Colon model

Validation at MEDIS Foundation (Rumania)

- Campina Municipal Hospital
- National Conference of Surgery (CNC)

3D printing + moulding techniques

Participants (n = 98)



Colon model

Validation at MEDIS Foundation (Rumania)

- Campina Municipal Hospital
- National Conference of Surgery (CNC)

Mixed Reality technologies

Participants (n = 66)

Colon model

Validation at EAES Congress 2023 (Rome, Italy)

- 3D printed model
- Mixed Reality application

Heart model

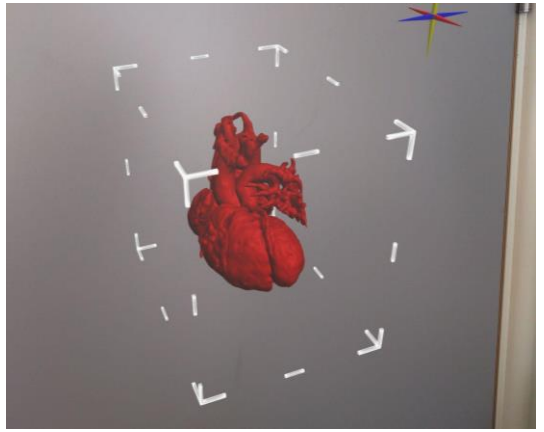
Oslo University Hospital

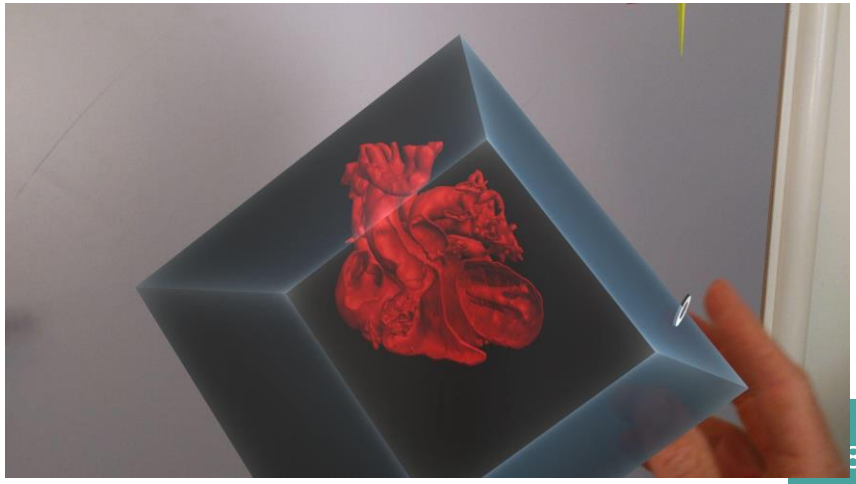
Objective

Anatomic understanding of complex congenital heart defects (CHD)

Models

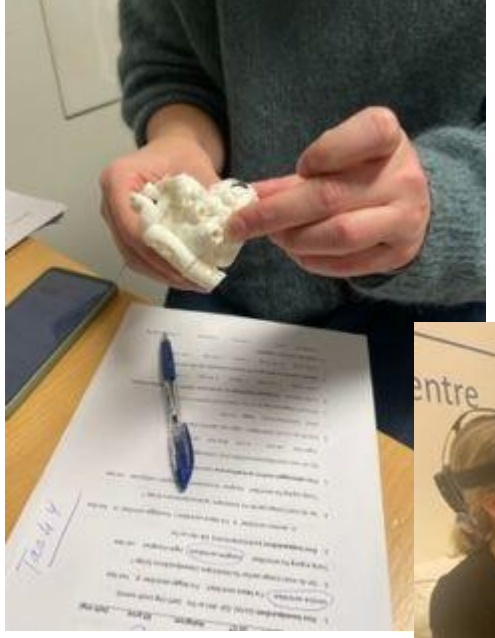
- 3D-printed model
- Holographic model for MR headsets

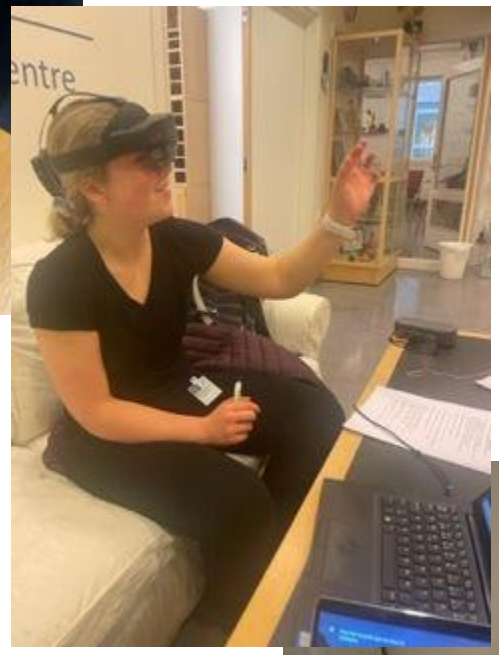




Heart model

Oslo University Hospital





Participants (n=30)

- Medical students in 4-5th year (n= 20)
- Cardiology residents and cardiologists without CHD training/experience (n = 10)

Validation scenarios

a. Scenario 1: Give a diagnosis using the 3D-printed model

b. Scenario 2: Give a diagnosis using the holographic model

c. Scenario 3: Give a diagnosis using a conventional CT scan

Shoulder model

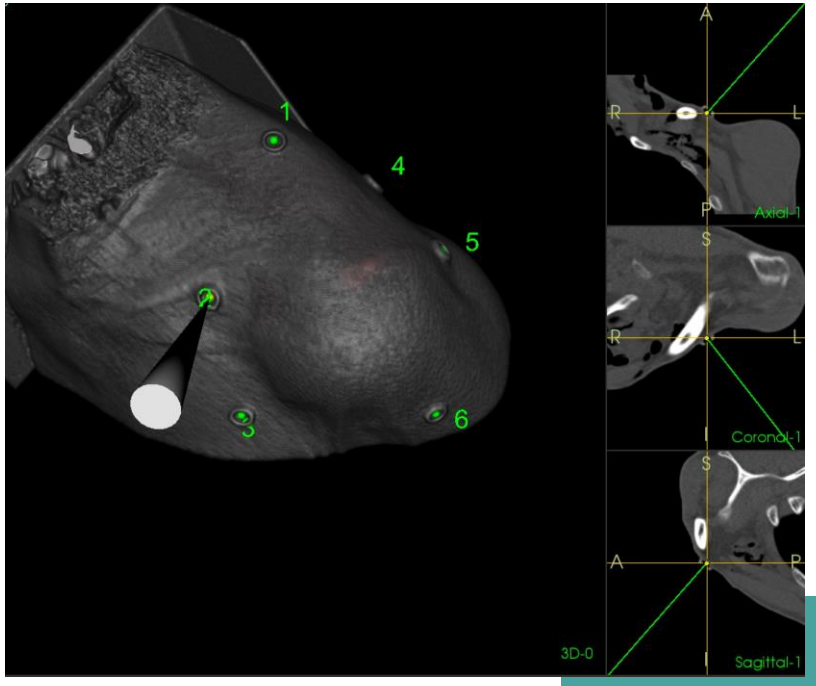
SINTEF & St. Olavs Hospital

Objective

To enhance anatomic understanding and increase performance for needle insertion in Subacromial injection in the shoulder.

Models

- A cadaver shoulder physical model
- 3D-printed model
- 3D navigation (augmented reality)



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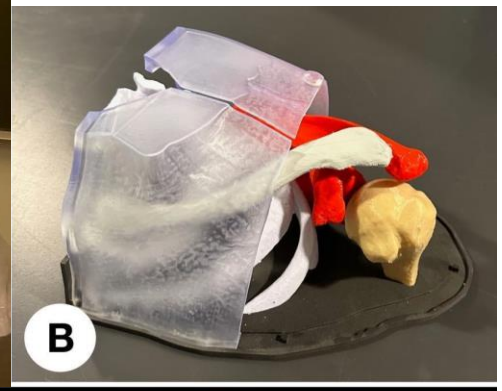
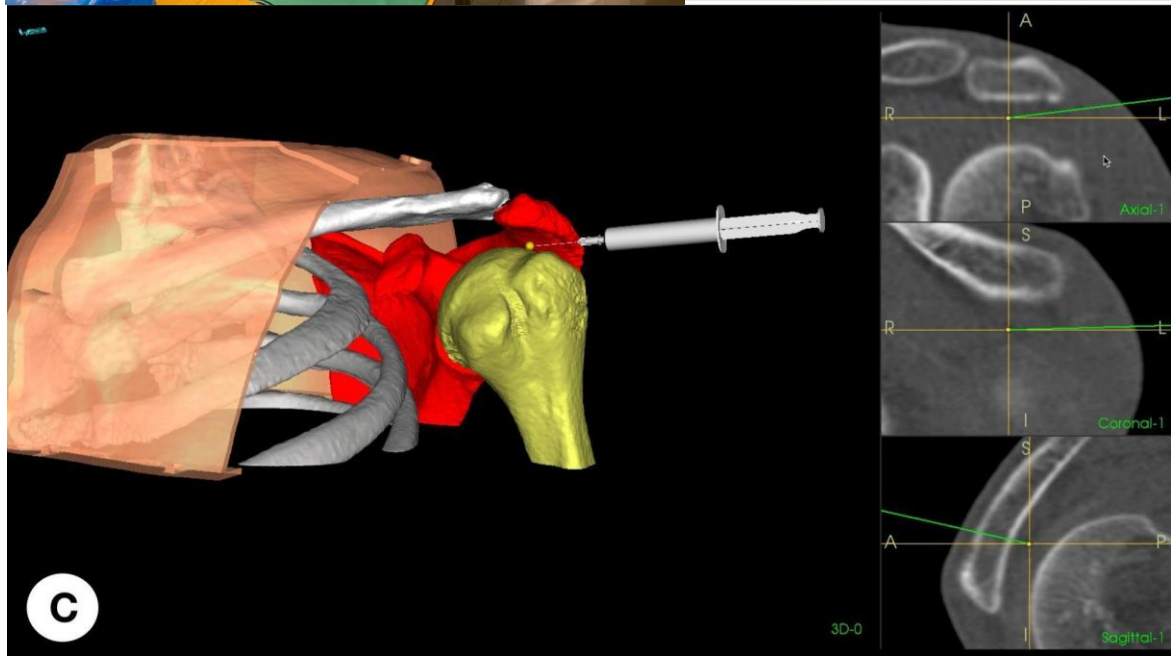
Shoulder model

SINTEF & St. Olavs Hospital

Participants: 30 medical students





Validation scenarios

Cadaveric model + EM tracker

a. Without previous training

b. With training using a 3D-printed model (transparent skin and bones)

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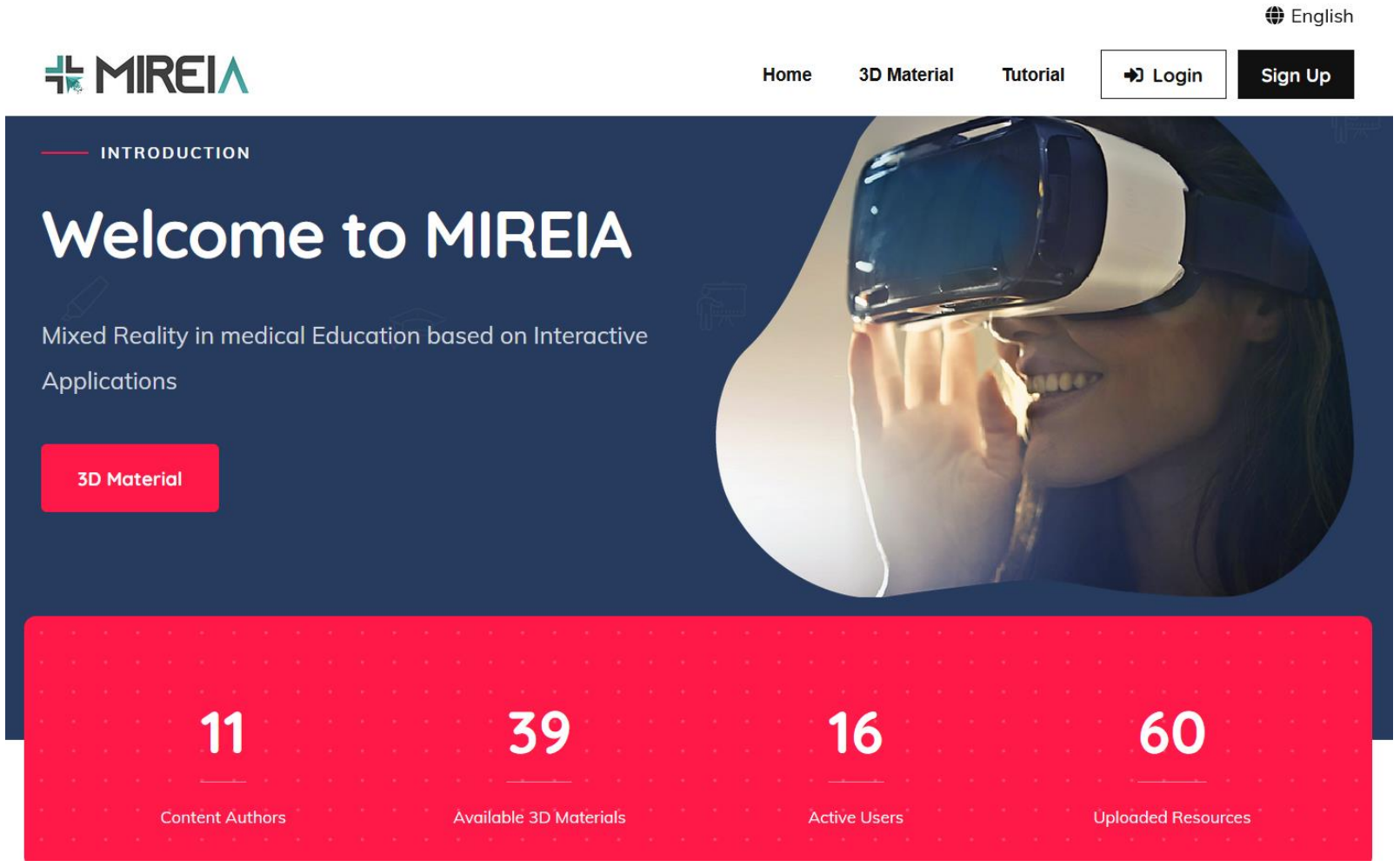
Online repository

https://mireia.avaca.eu/



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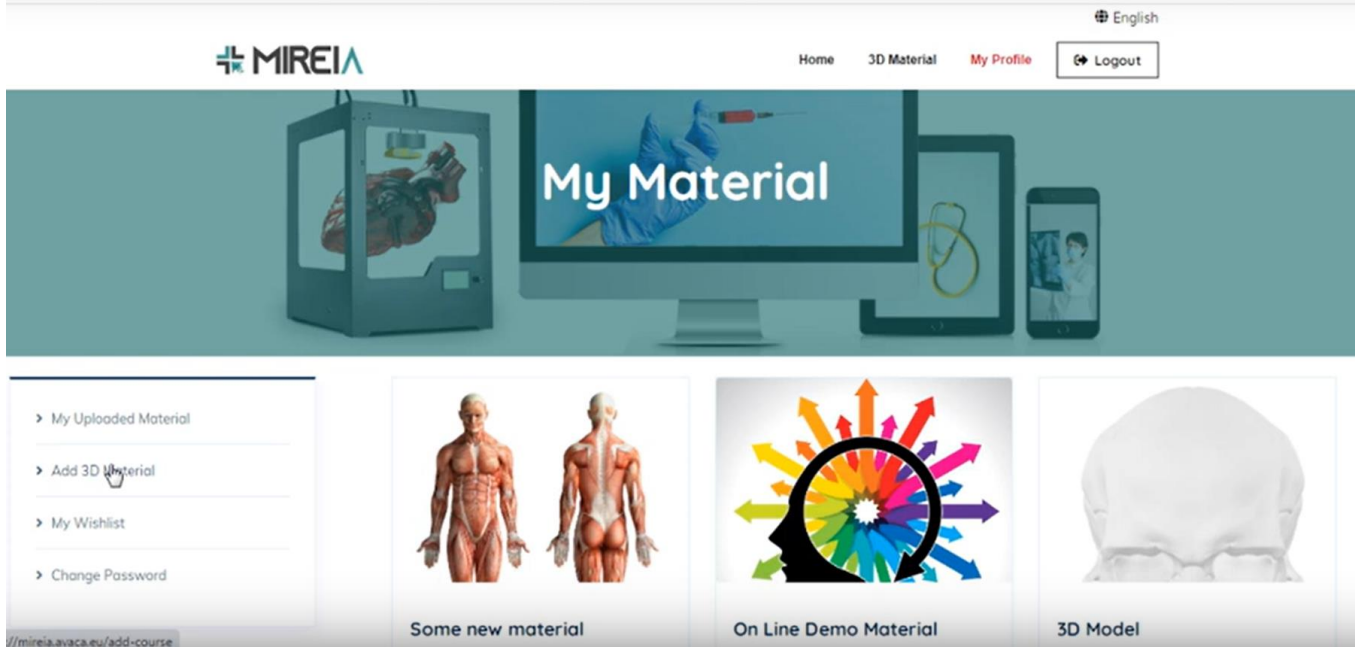

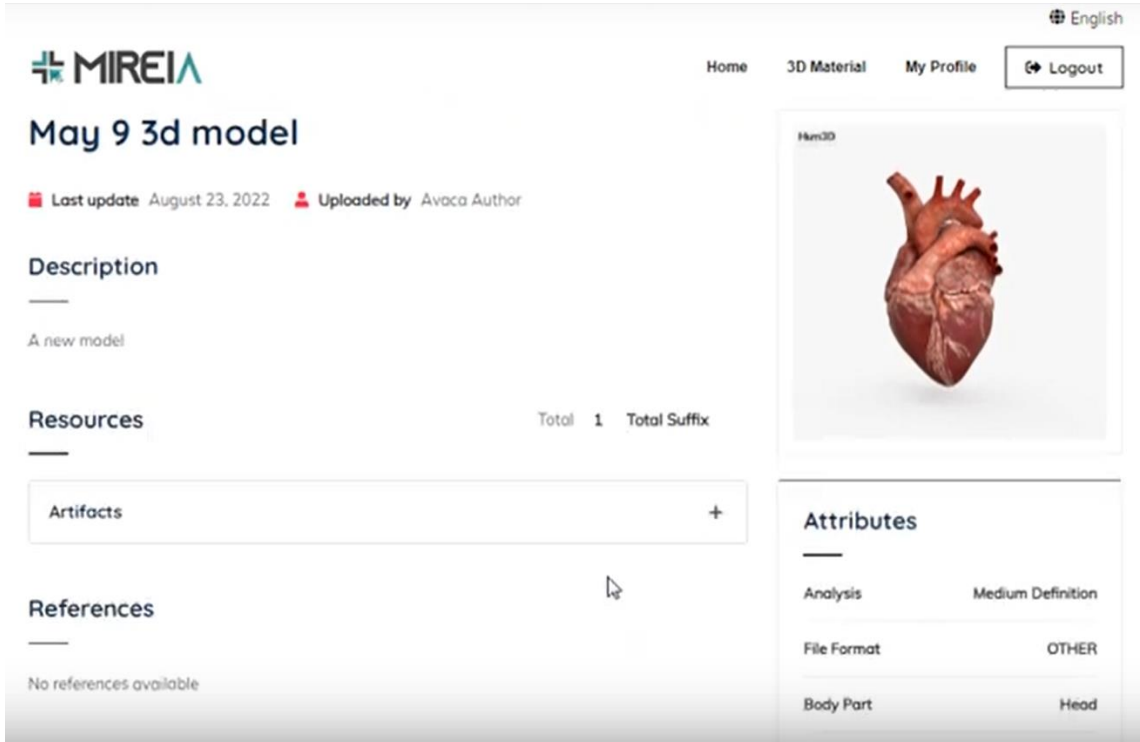

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Website

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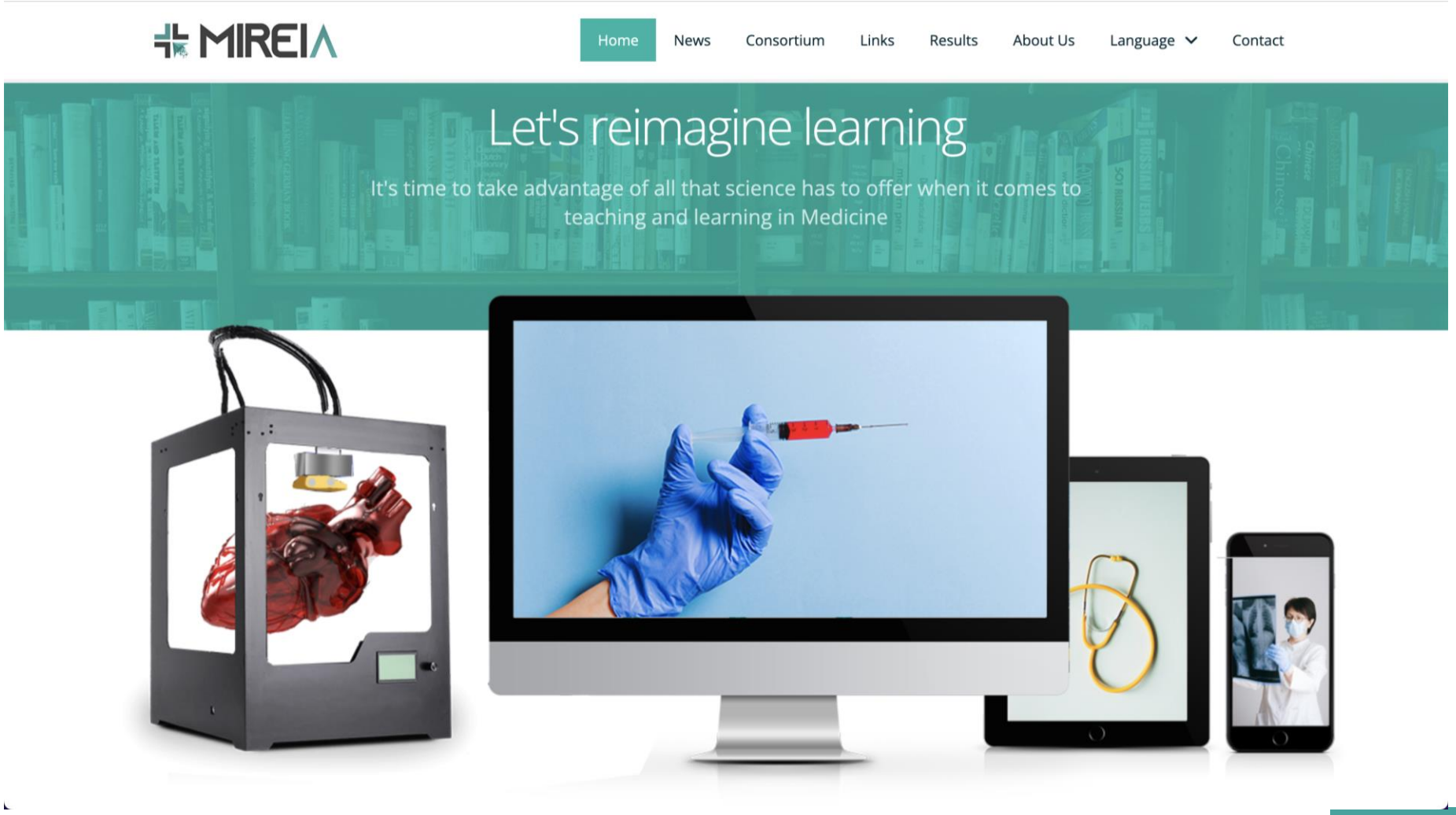

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