

VR/AR IN EDUCATION





Top Benefits of VR in Education

Improves understanding

Improves attention and engagement

Learning through experience

Virtual Field Trips

Encourages imagination and curiosity

Scalable VR Training

Improves attention and engagement



Types of Virtual Educational Environments



Different types of VR used for the purpose of education: VR environment using common mouse/keyboard on a stereoscopic display; Experience room used to show tsunamis; a Science educator in a primary school taking students to virtual Egypt via the Google Expeditions App.



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Types of Virtual Educational Environments



Selected examples that affect immersion level in VR-based education. From left:
Immersive system based on wearable devices for providing on-the-job training. Tilt
Brushas: a tool in VR education. Virtual Reality Cycling Platform. Haptic feedback system
used with Simodont for teaching dental procedure



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Tilt Brush



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Simodont Dental Trainer



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Educational VR Applications

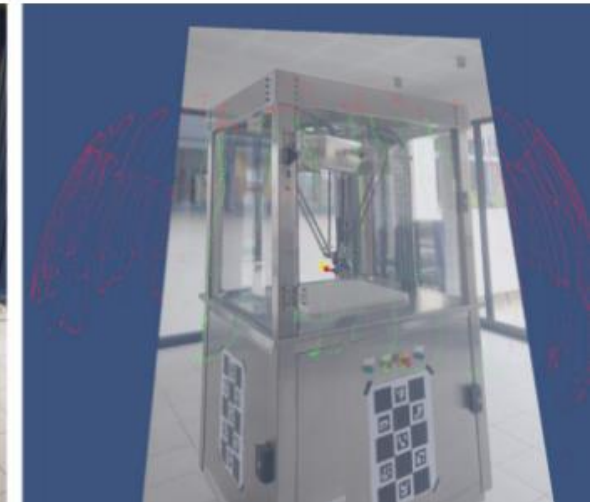
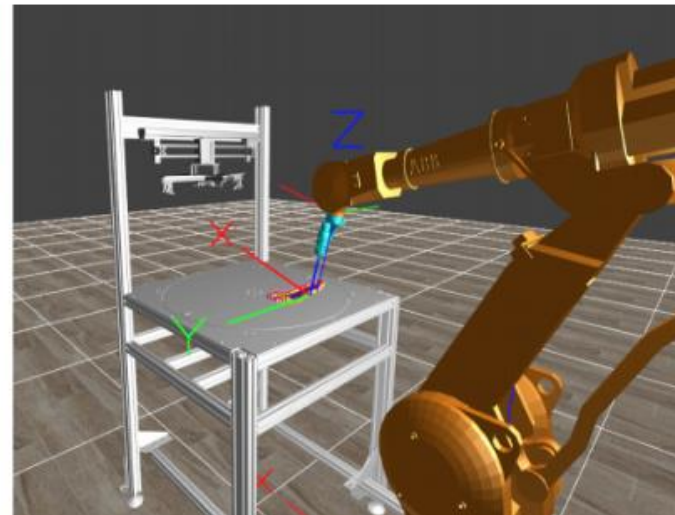
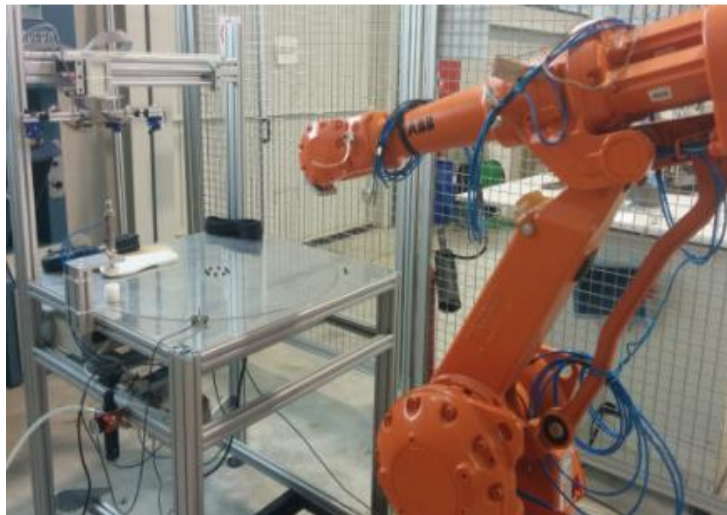
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Engineering Education





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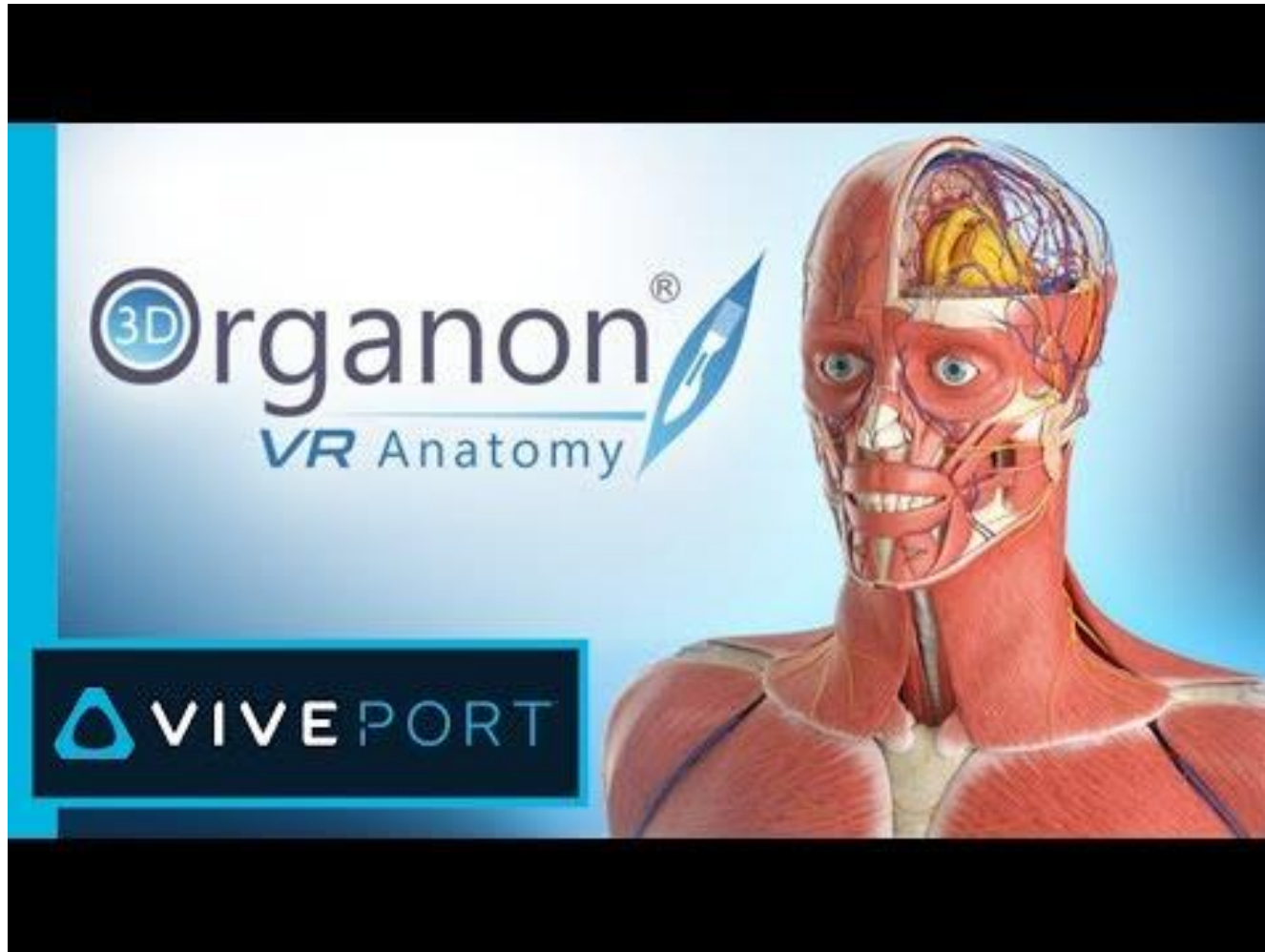


Medical Education





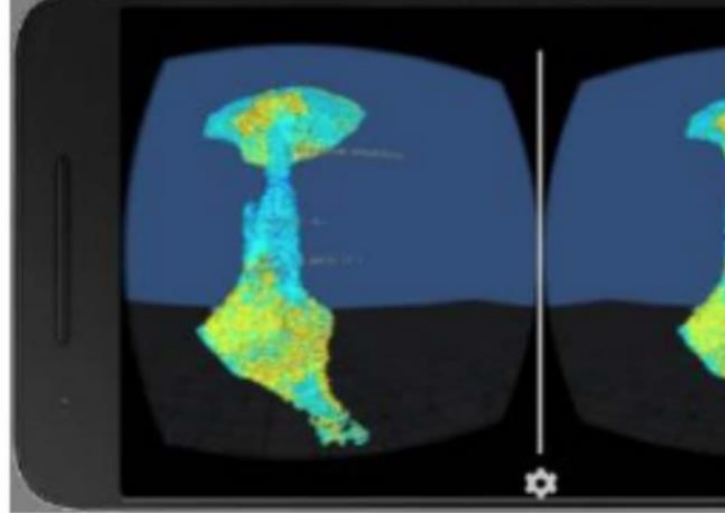
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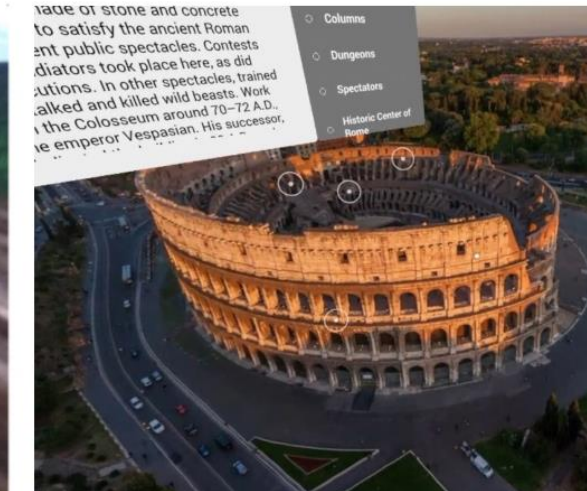
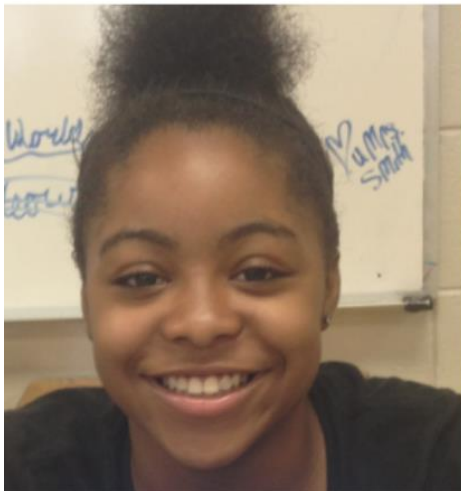
3D Organon
VR Anatomy
Medis Media



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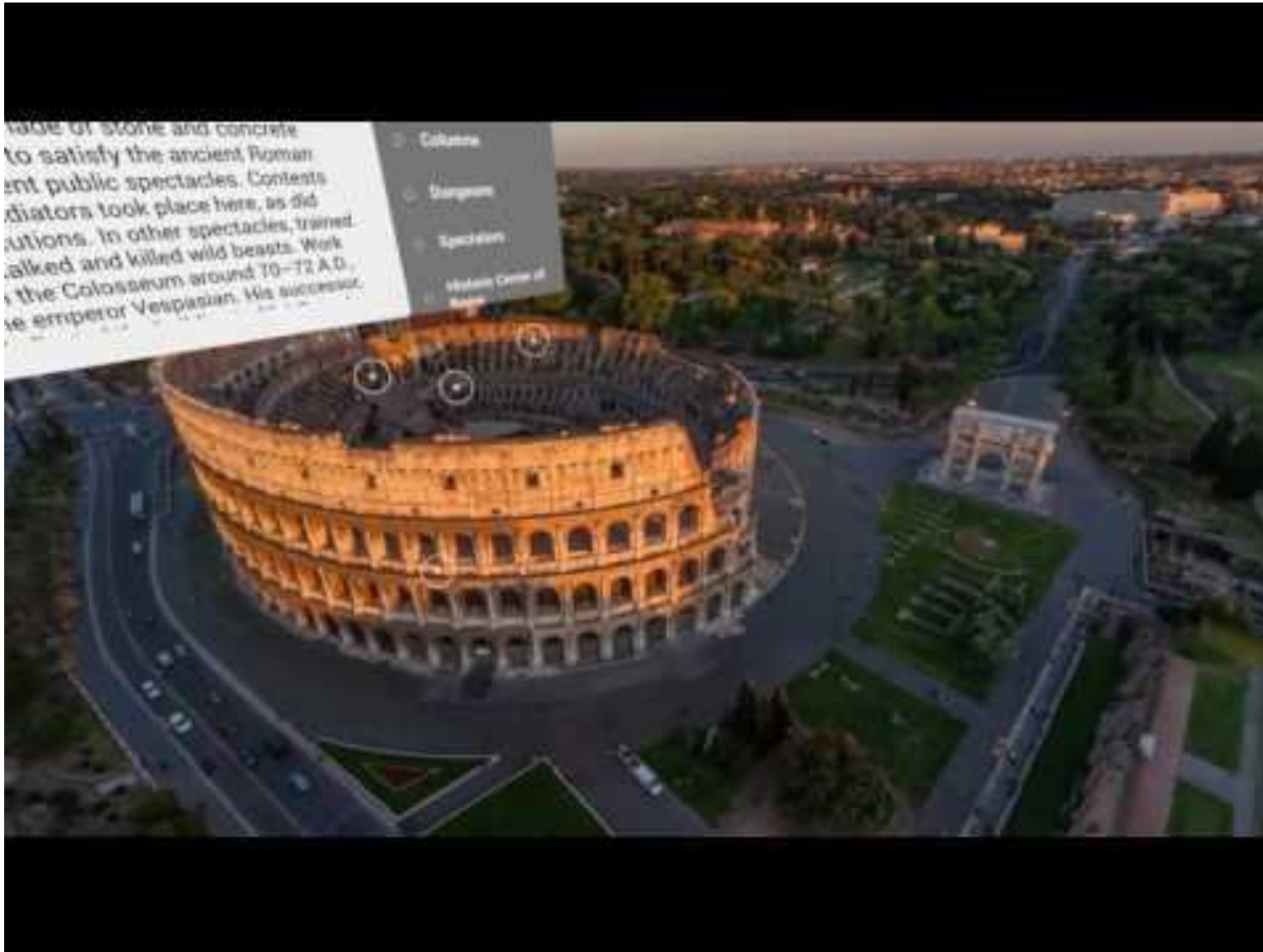


General Education





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Google Expeditions



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Special Needs Education



Left: User interacting with components of VR system.

Middle and Right: VR environment that participants moved through while walking on the treadmill.



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Evaluation Methods

- [System Usability Scale \(SUS\)](#) - consists of 10 item questionnaire with 5-point scales numbered from 1—strongly agree, to 5—strongly disagree.
- Evaluating questions, less general or tailored for the purpose of specific application.
- Pre and post-tests (connected with the goal of the app) - evaluation of the progress.
- External sensors (e.g. heart rate, eye tracking, motion tracking) - recognition the level of engagement.



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Challenges and Issues



LACK OF VISUAL REALISM AND REALISM OF THE
DYNAMICS AND INTERACTION;



REALISTIC VR ENVIRONMENTS REQUIRE
COMPUTATIONALLY POWERFUL HARDWARE FOR
RENDERING, WHICH GOES HAND IN HAND WITH THE
PRICE.



HUMAN FACTOR AND PHYSICAL SIDE EFFECTS ARE
ANOTHER ISSUES (VR SICKNESS, NEGATIVE EFFECT ON
DISSOCIATION OF ACCOMMODATION/CONVERGENCE
AND CARDIOVASCULAR CHANGE.



VIMELA (case study in Mechatronics)

Motivation:

- access to simulations of state-of-the-art equipment, which rarely available or too expensive;
- more accessible laboratories due to reduced need of supervision;
- attractive teaching tool tailored to fit the curriculum;
- possibility to prepare the students for future work (i.e. by providing specific machinery specifications to be put in the VR application).





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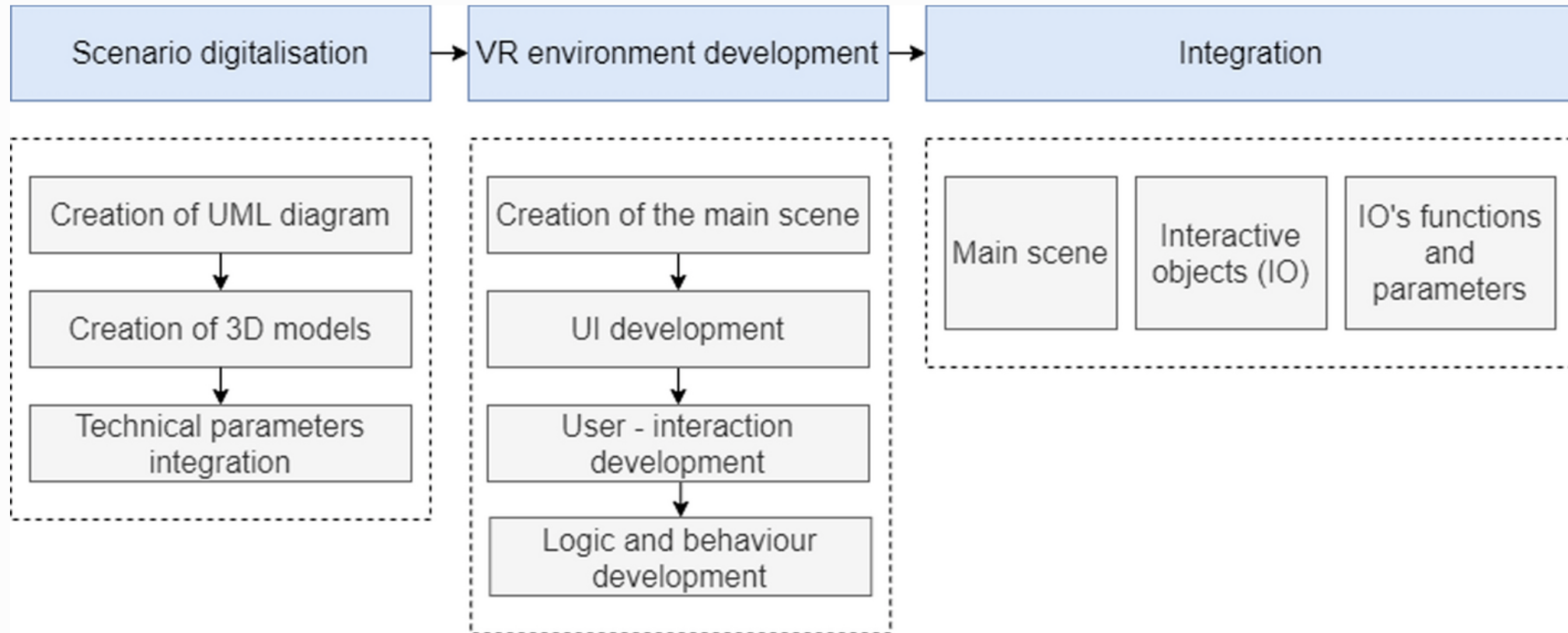


VIMELA (CASE STUDY in Mechatronics)





VIMELA (CASE STUDY in Mechatronics)



Stages of creating the VR training application

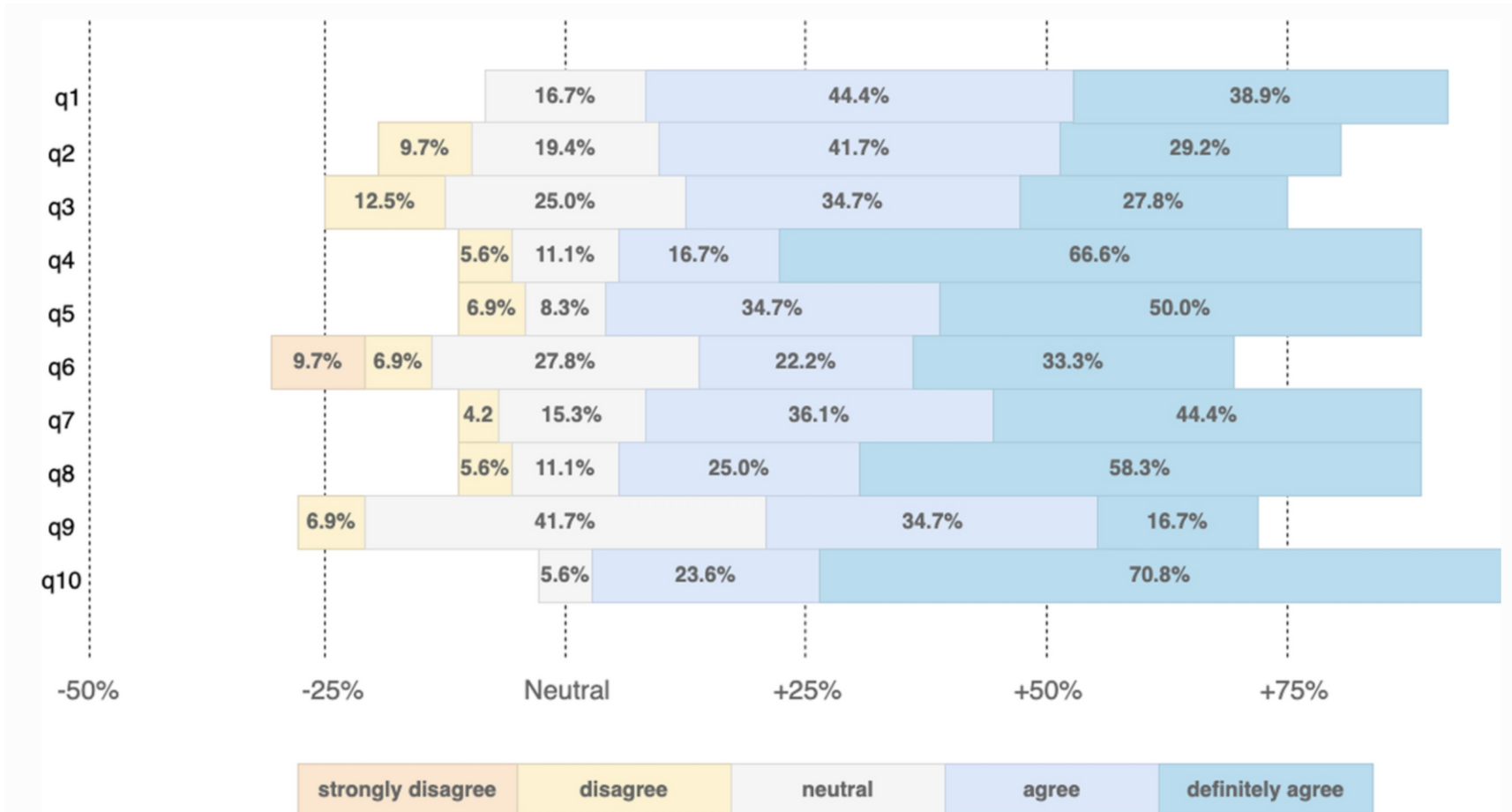


No	Question
q1	I felt very comfortable during the session
q2	Nothing bothered / interrupt the immersion
q3	I found the visual part of VR environment realistic
q4	I do not feel eye strain
q5	I do not feel discomfort
q6	I would imagine that I would use VR on daily basis
q7	I find VR presentation useful for memorization
q8	I find VR presentation useful for understanding
q9	The presented device seem real
q10	I would like to use the system as a part of classes

VIMELA (case study in Mechatronics)



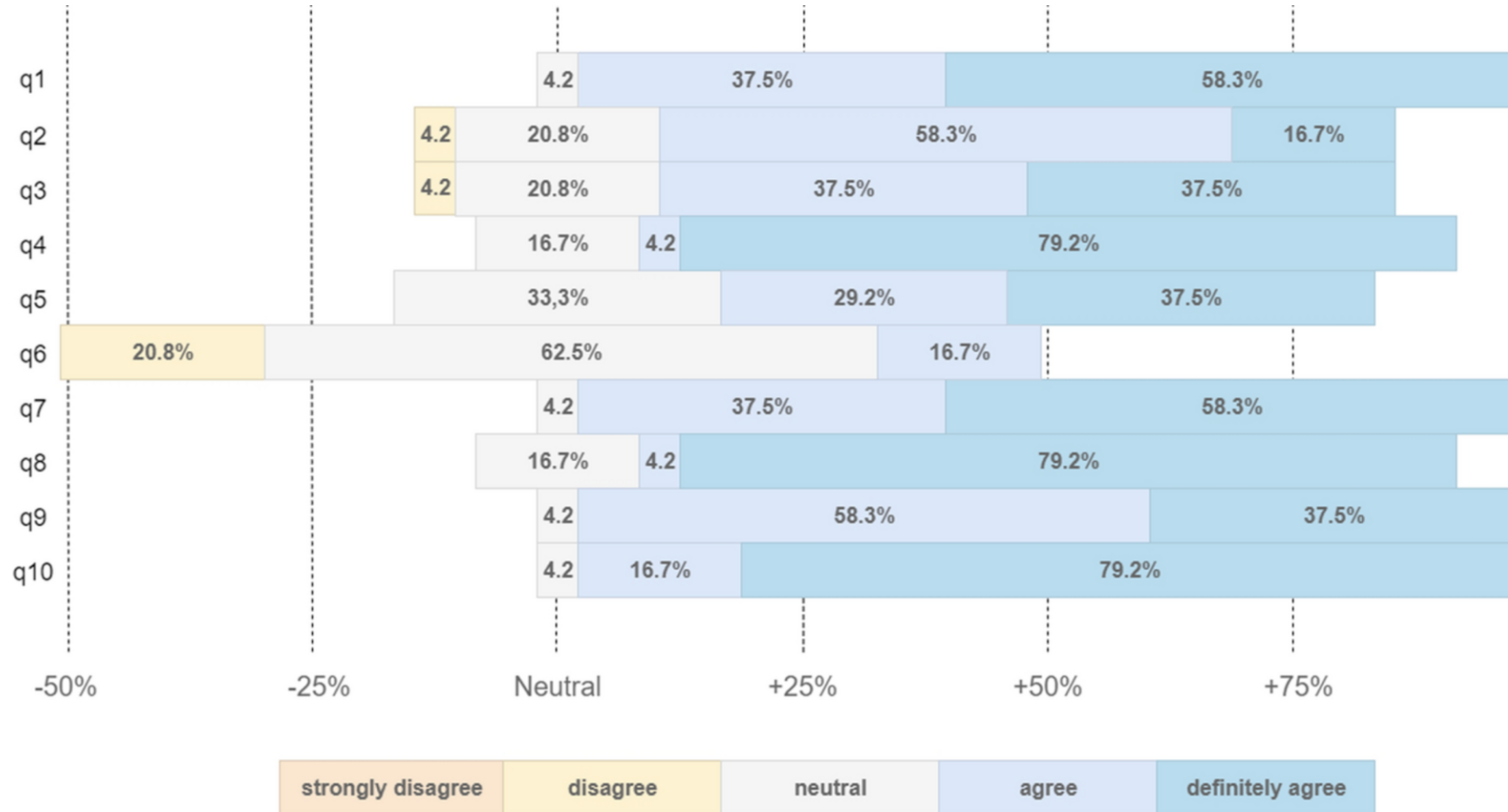
VIMELA (CASE STUDY in Mechatronics)



Results of SUS questionnaire for the group of students



VIMELA (CASE STUDY in Mechatronics)



Results of SUS questionnaire for the group of academics



VIMELA (CASE STUDY in Mechatronics)

Subjective assessment of educational values of VR application

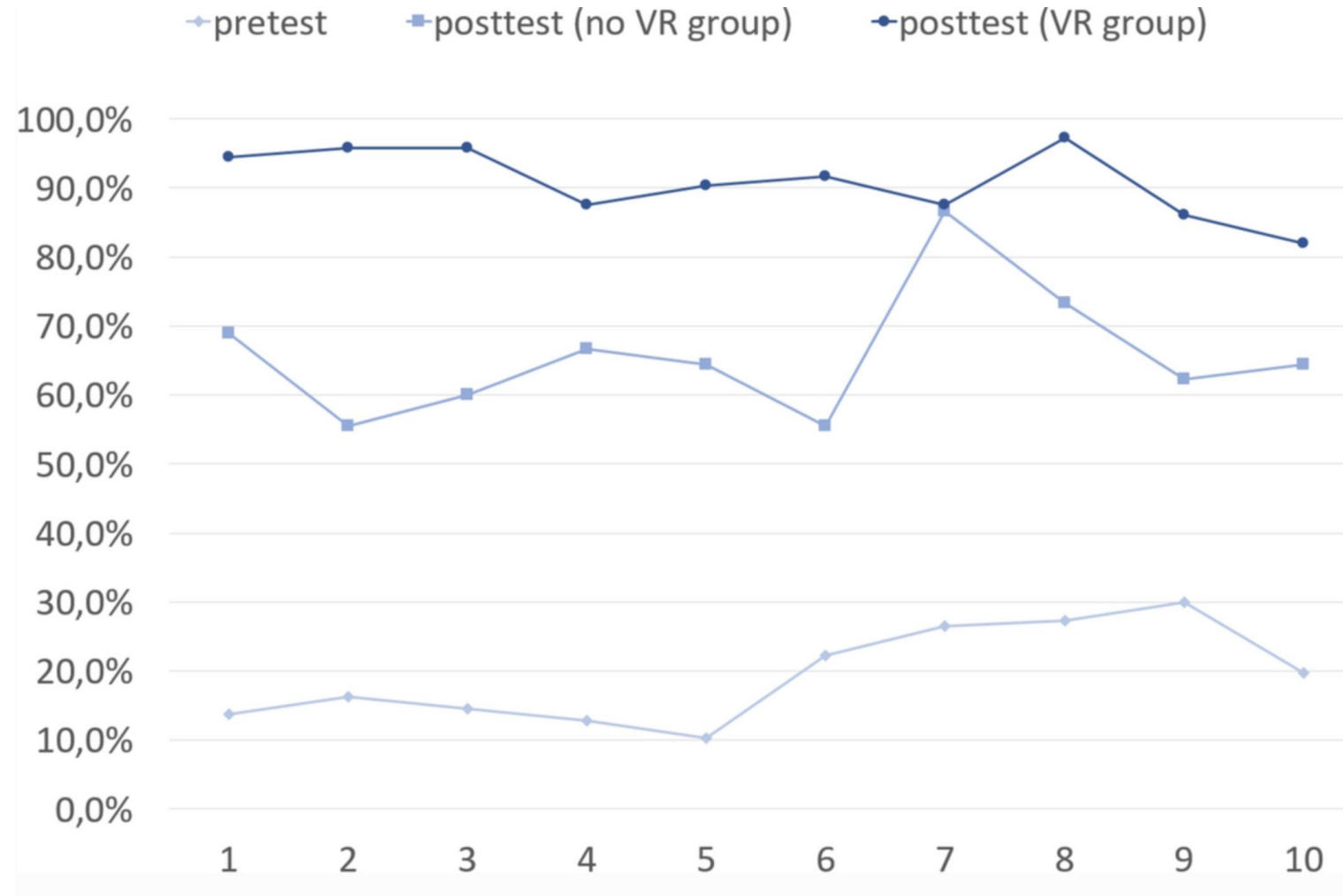
Questions	Mean	STD
#1 The exercise allowed me to understand the fundamentals of the basic structural part of electrical machines	4.28	3.28
#2 The sequence of actions for assembling the electrical machines was logical	3.94	4.57
#3 Performed actions gave predictable results	4.72	4.76
#4 All performed actions were relevant and necessary	3.67	3.61
#5 The exercise has added value in comparison to real-world practice	4.71	4.55
#6 The exercise can be used instead of real-world practice	3,85	3,05
#7 The exercise allowed me to understand the fundamentals of testing of electric motors	3.60	3.46
#8 The sequence of actions for preparation of the test bed for measurements was logical	3.82	2.76
#9 All actions were quite realistic and close to real lab testing	3.17	5.64
#10 Would you like to use this VR approach latter in other courses?	4.61	4.28



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VIMELA (CASE STUDY in Mechatronics)





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AR in EDUCATION





AR vs. education domains

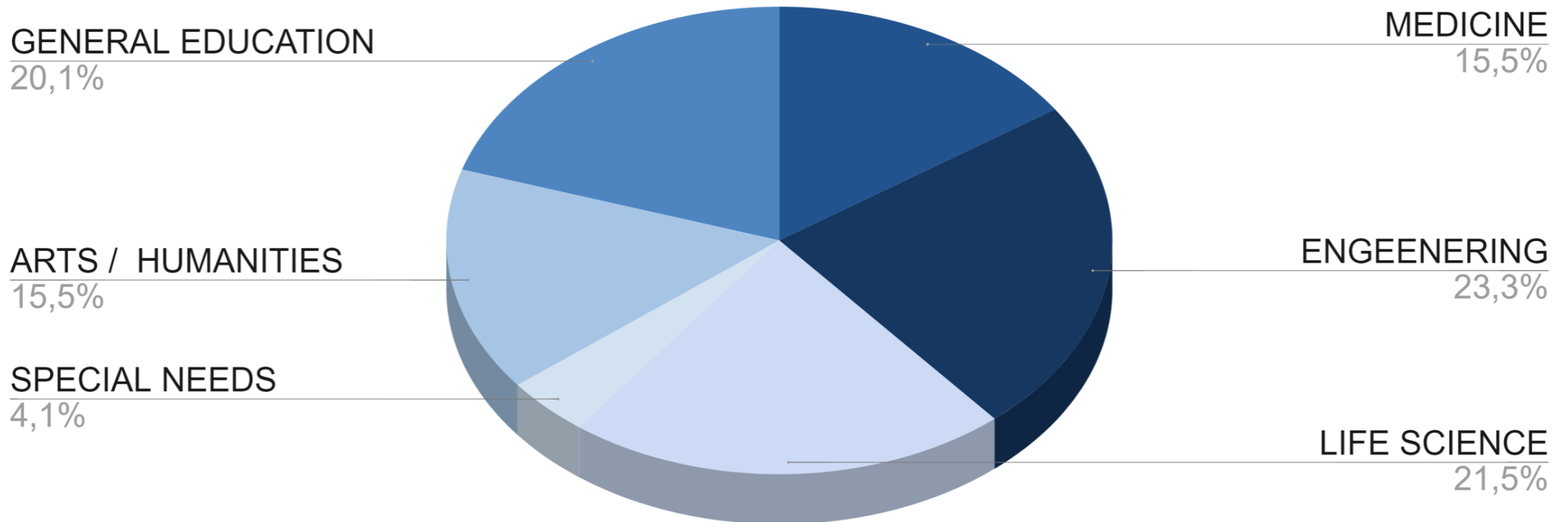
Scopus keywords search.

```
TITLE-ABS-KEY ( "augmented reality" )  
AND ( TITLE-ABS-KEY ( "education" ) OR  
TITLE-ABS-KEY ( "learning" ) OR  
TITLE-ABS KEY ( "teaching" ) )  
AND ( LIMIT-TO ( PUBYEAR , 2019 )  
OR LIMIT-TO ( PUBYEAR , 2018 ) )
```





AR vs. education domains



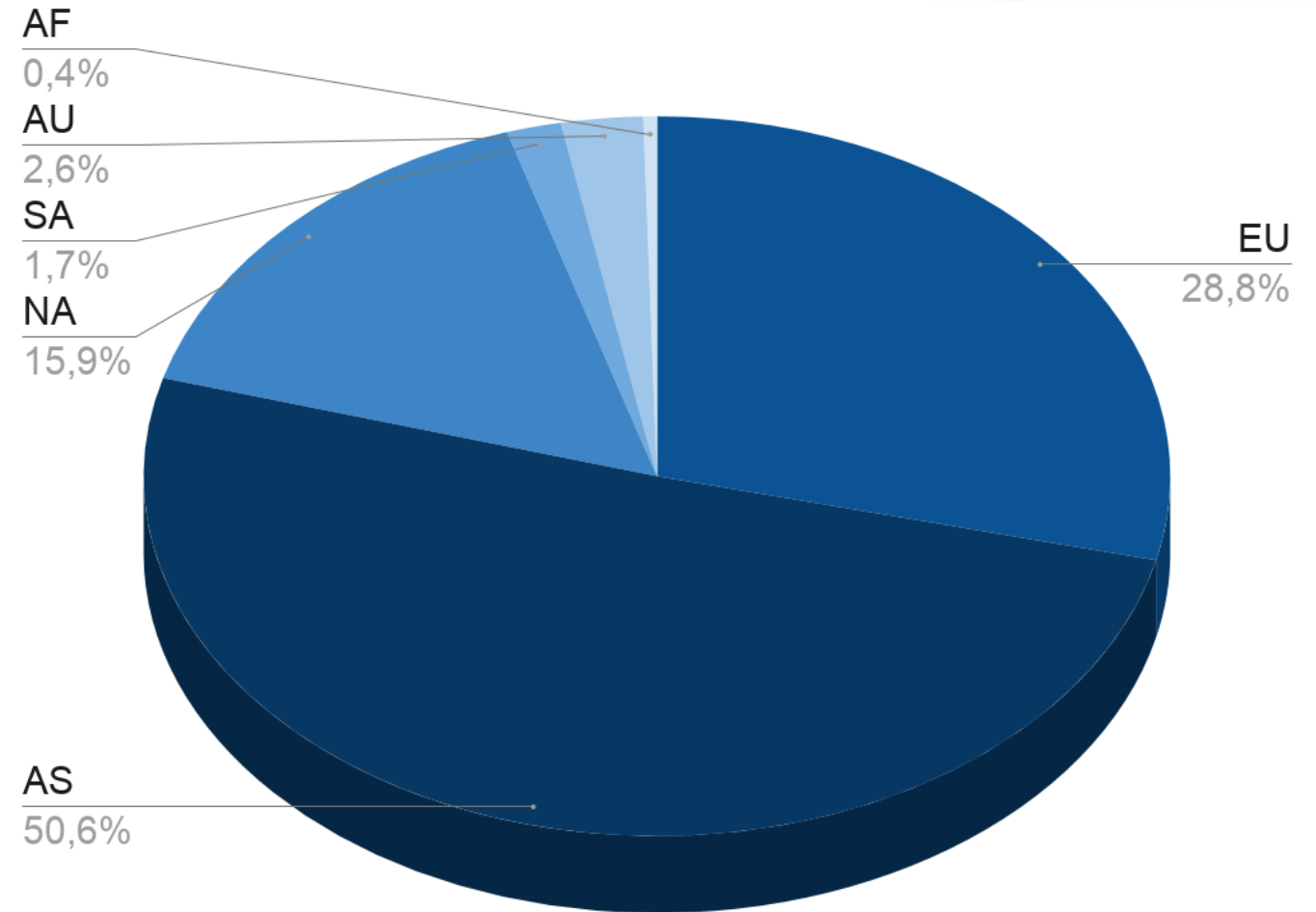
Percentage distribution of the most popular education domains based on Scopus keywords.



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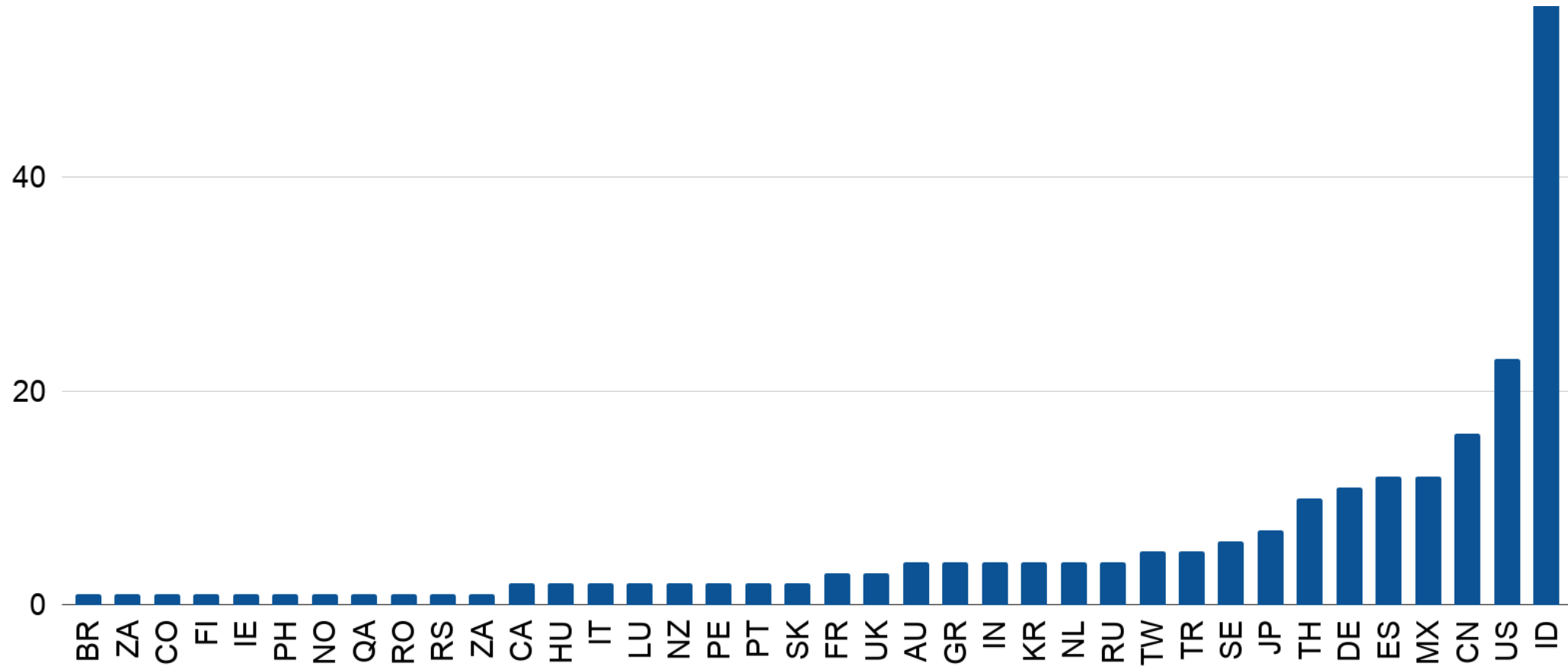


AR vs. the world



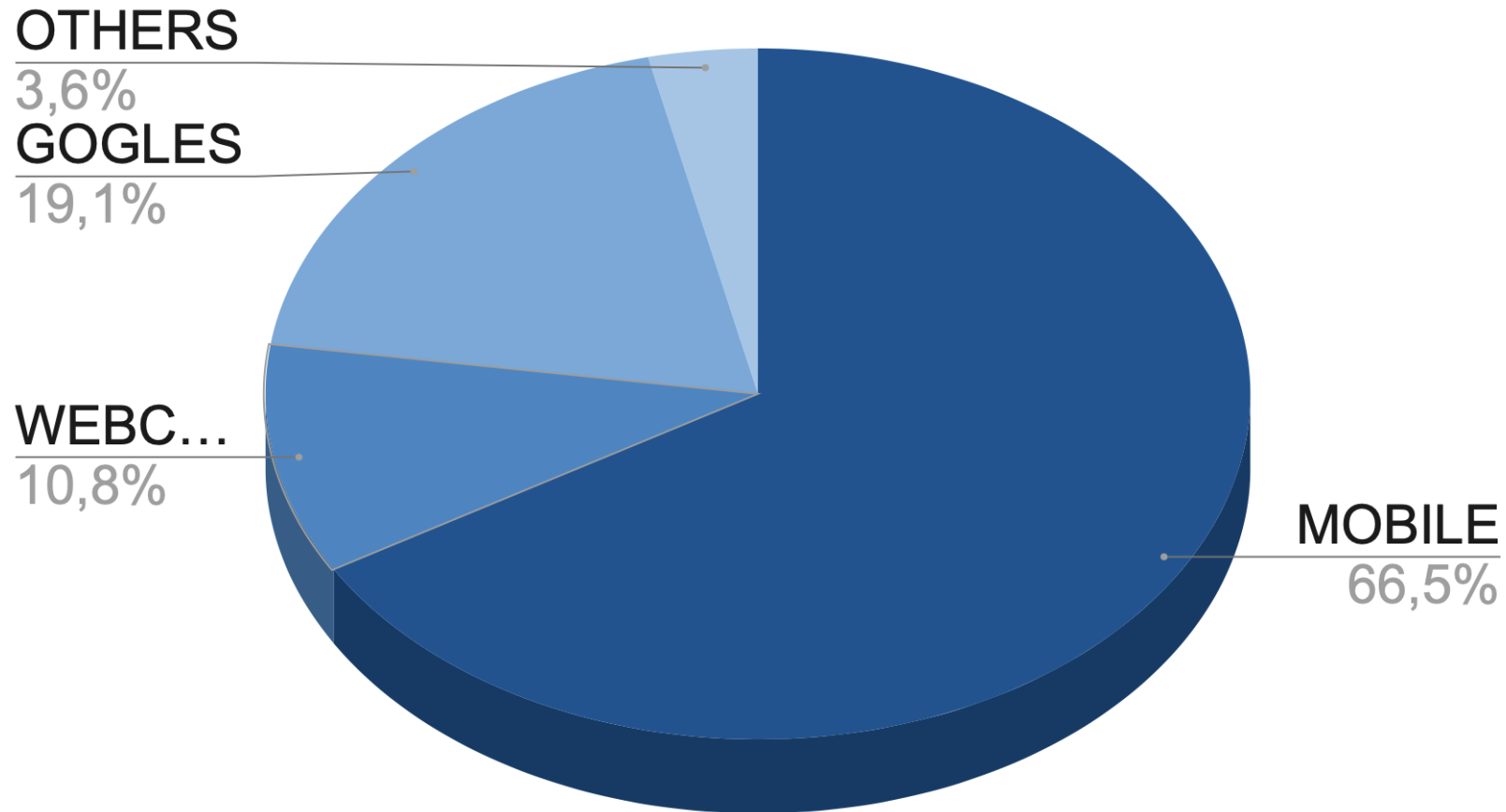


AR vs. the world





AR tools





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AR in engineering



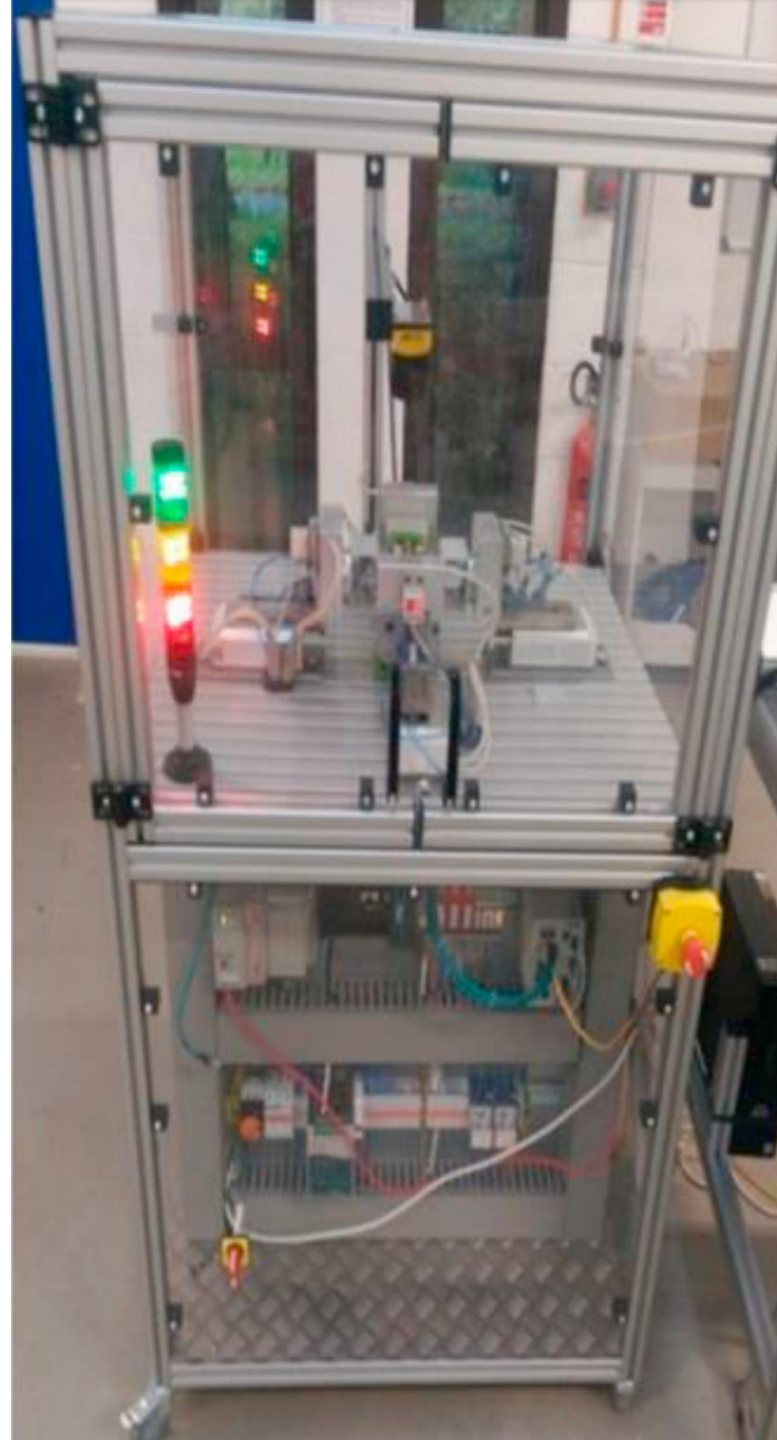
Tablet and HoloLens glasses scenario presenting the analysis of an electric actuator.



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AR in engineering

Physical manufacturing cell and its
virtual equivalent.





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AR in general
education



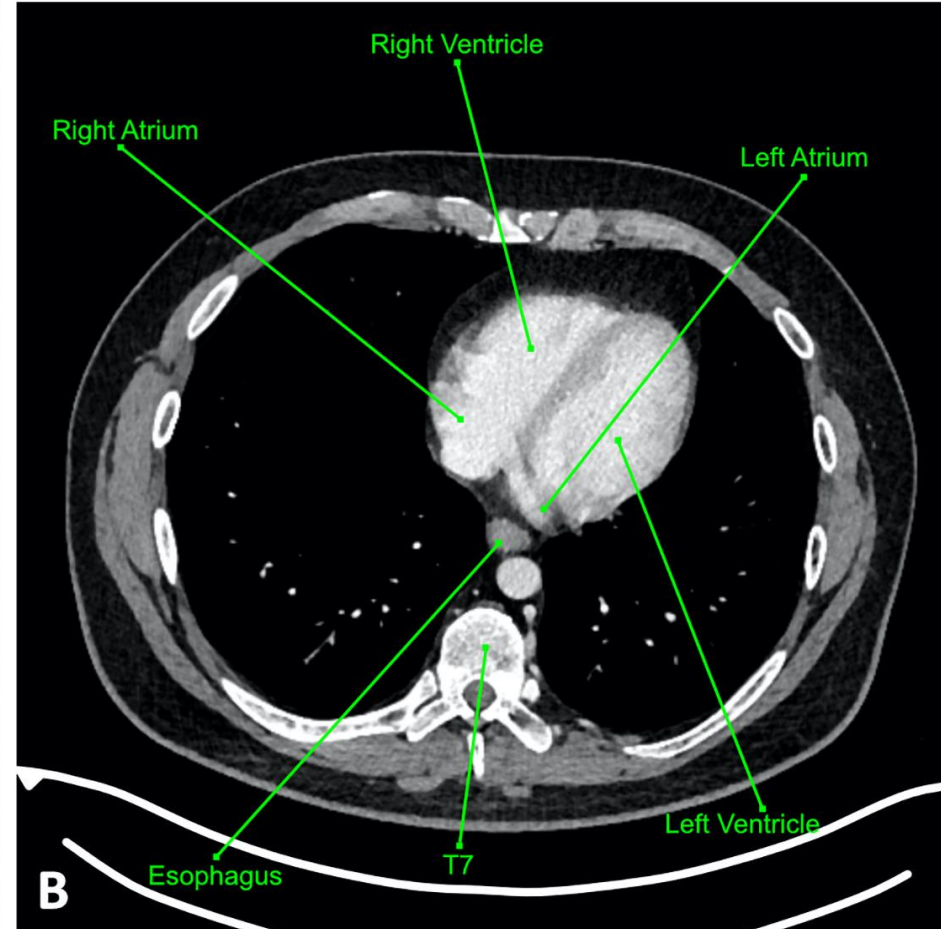
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AR in life
science



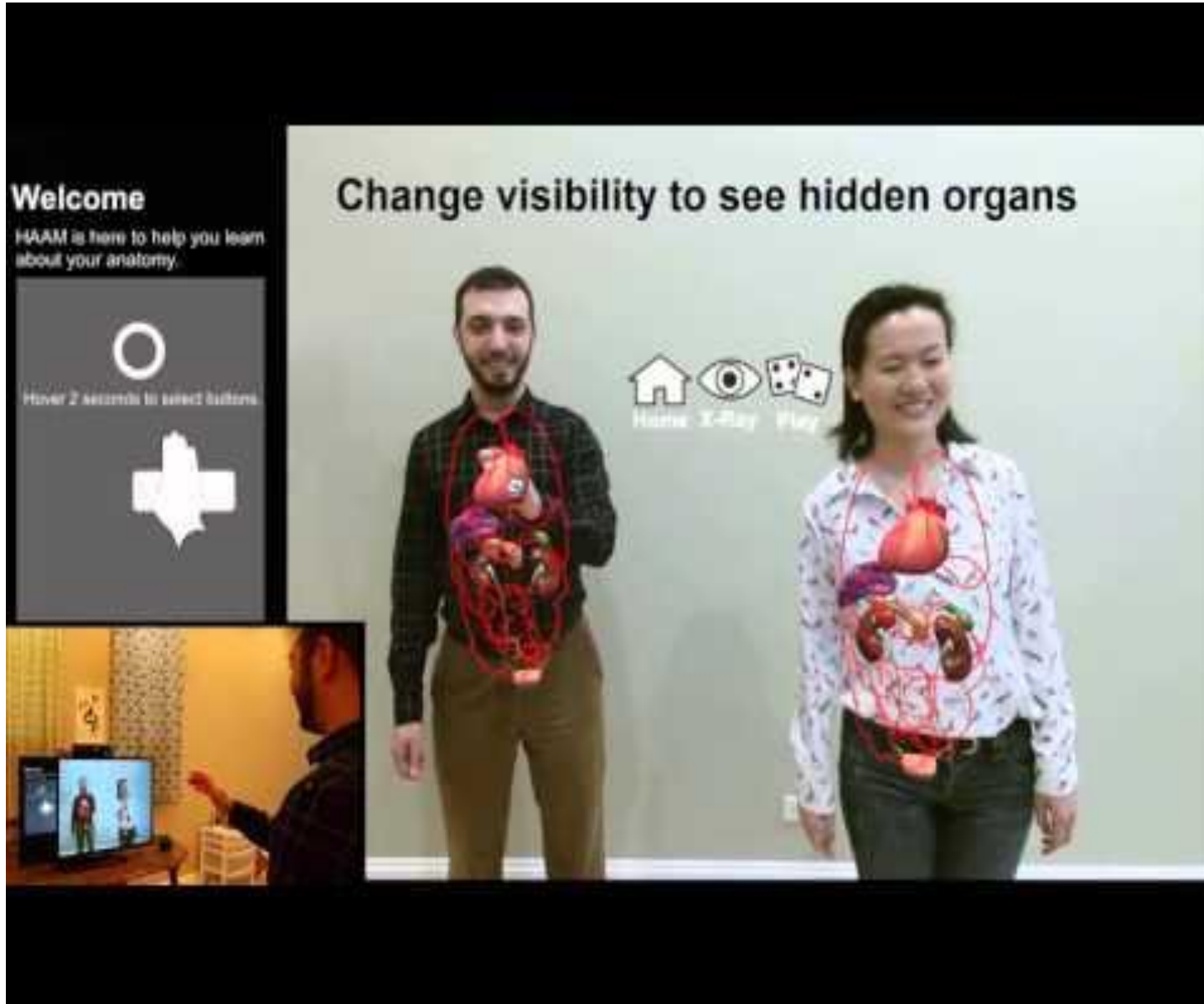
AR in medicine



(A) Magic Mirror system:
AR view with virtual
anatomy models super
imposed on the user;
(B) CT section image
corresponding to the
slice at the height of the
virtual redcircle in the
AR viewext



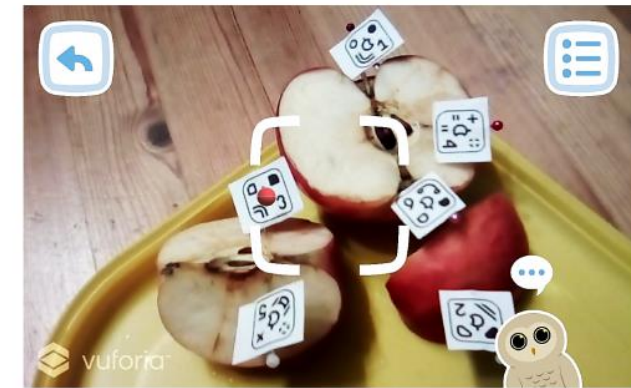
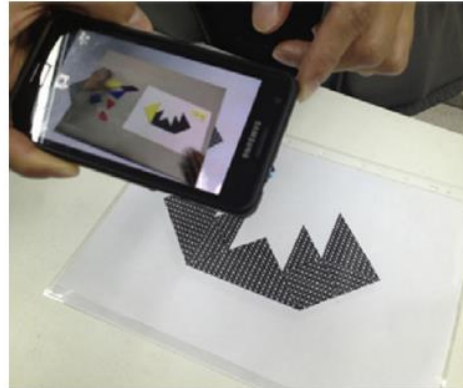
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Human Augmented Anatomy Mirror



AR for special needs education



AR for special needs education (a) currency learning system (b) an app for independently learning geometry (c) sample AR models on flash cards used for speech therapy (d) the application Fancy Fruits, used to teach disabled children about regional fruits and vegetables.

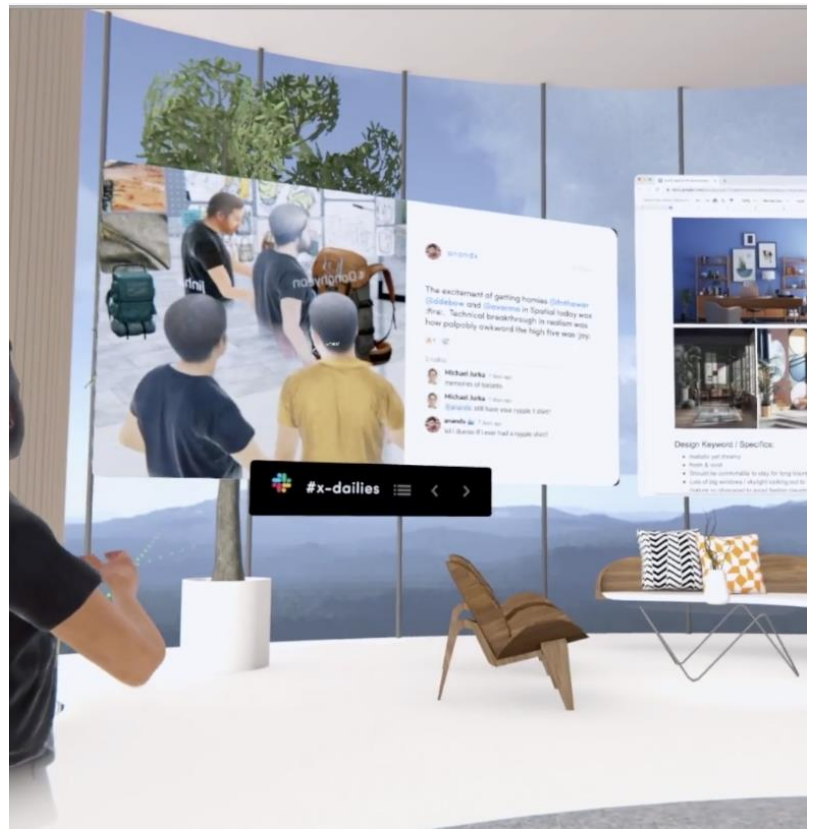


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**VIRTUAL
TECHNOLOGIES**
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Spatial



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Spatial

Work, talk and stand

Work, talk and stand next to each other from across the world;

Create

Create your own 3D-realistic avatar;

Talk, move, and interact

The avatar can talk, move, and interact with objects inside virtual room;

Upload

Upload 3d models + 2D images, videos, and PDFs;



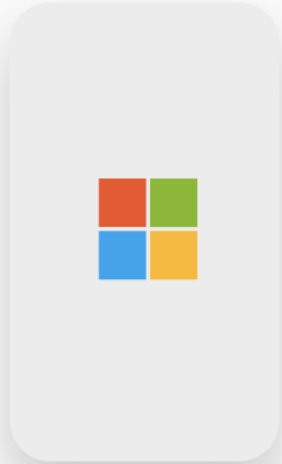
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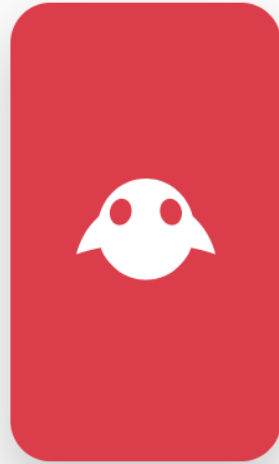
Spatial



**Oculus
Quest**



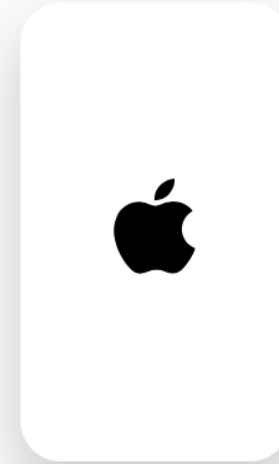
HoloLens



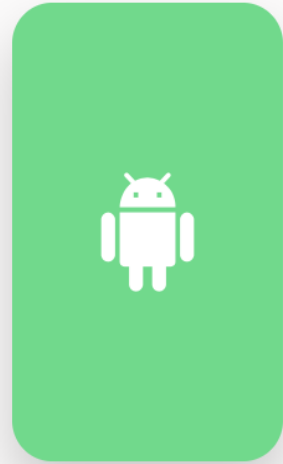
**Magic
Leap**



Web



iOS Beta



**Android
Beta**