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University of Pisa – PhD in Computer Science
Mauriana Pesaresi seminar series

Unlocking the potential of Virtual and Augmented Reality in inclusive adult education

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LEARNING CRISIS

617 million children and adolescents do not reach the minimum level of school competence

- Unesco Institute for Statistics

But... **68% have access to education**

So, not only

- Lack of access and accessibility to education

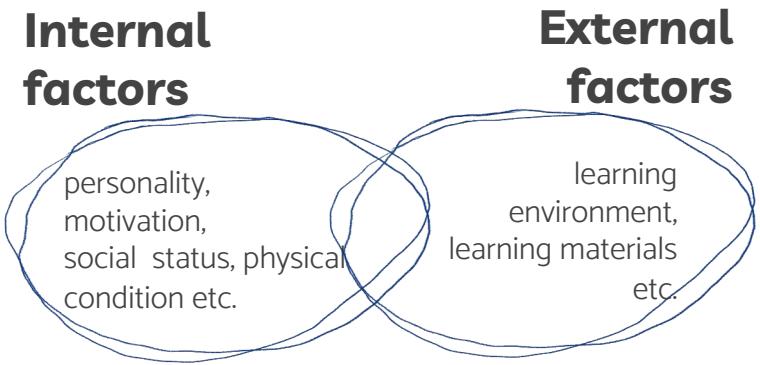
But also

- Failure to keep people in school
- Poor quality of education

It is worse for people with disabilities

3%

Literacy rate for adult with disabilities



Obstacles to learning arise from students' interaction with **inflexible teaching methods**, not from their abilities

Universal Design for Learning as a solution

Framework for designing and delivering flexible approaches to teaching and learning that address students' diversity within an educational context

Goal: to improve the teaching and learning process for all students by creating universal access to educational practices, materials and environments

Principles:

- Provide multiple means of **engagement**
- Provide multiple means of **representation**
- Provide multiple means of **action** and **expression**

INFORMATION & COMMUNICATION TECHNOLOGIES enabling UDL adoption

- Increasing student motivation
- Facilitating the acquisition of skills
- Improving teacher training
- Enabling personalisation of learning

ICTs benefit **students with disabilities**, by providing alternatives **to adapt the learning environment to different learning models**.

Digital content, learning objects, serious-games, digital sharing platforms, edutainment practices, etc.

The potential of IMMERSIVE TECHNOLOGIES

Augmented Reality and **Virtual Reality**

- Meet UDL principles
- Ensure personalisation
- Facilitate learning
- Provide possibilities for context-based experiences
- Foster creativity and imagination

Useful for **students with disabilities**

Multisensory engagement | Attention-grabbing | Self-awareness

However

AR and VR are still little used in educational contexts and most proposals in the literature refer to children

Several systematic reviews on the use of digital technologies for the implementation of UDL

But

A much narrower scope

Approaches used for **CHILDREN**

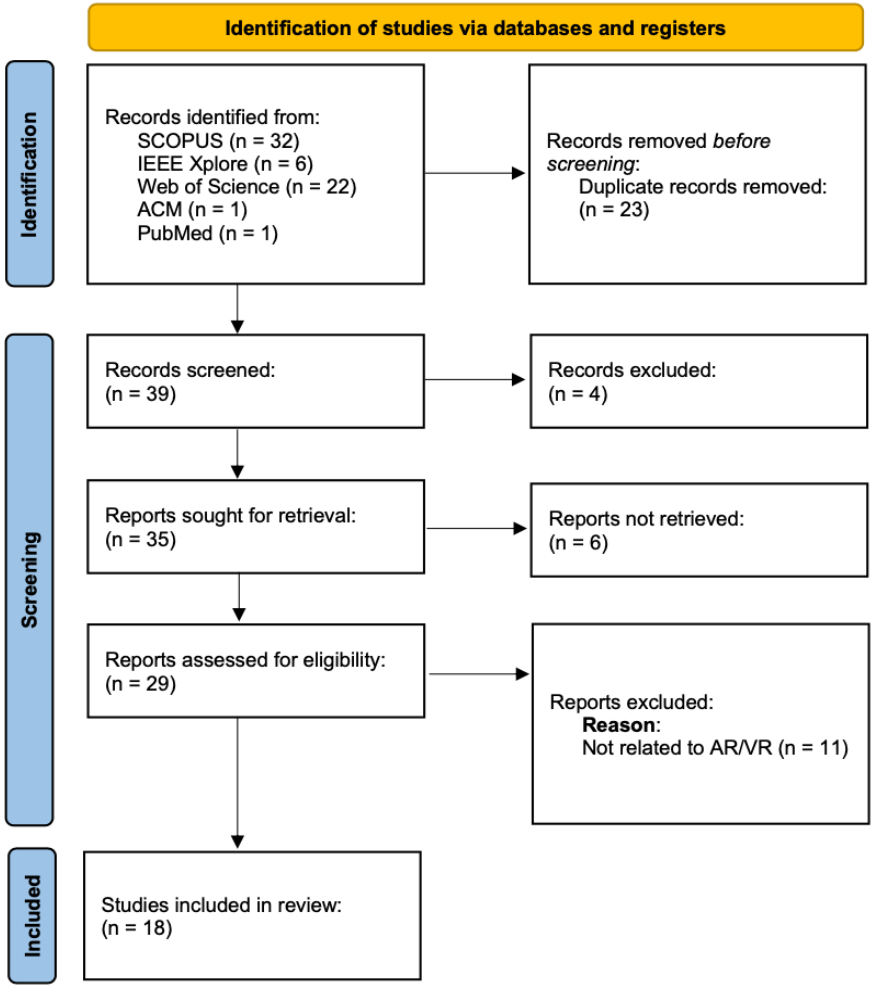
TEACHERS as the only beneficiaries

STUDENT OUTCOMES as the only focus point

Focus on:

- Adult learning
- Innovative ICT approaches to UDL
- AR and VR
- Understanding needs

REASONS for performing this SRL



METHODOLOGY

PRISMA

Identification:

("universal design for learning" OR udl)

AND

(reality OR metaverse)

- Limitation → articles in the last 10 years
- Databases → Scopus, IEEE Xplore, Web of Science, ACM Digital Library, PubMed

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QUERY 2: *(digital AND education AND inclusive)*

AND

(reality OR metaverse)

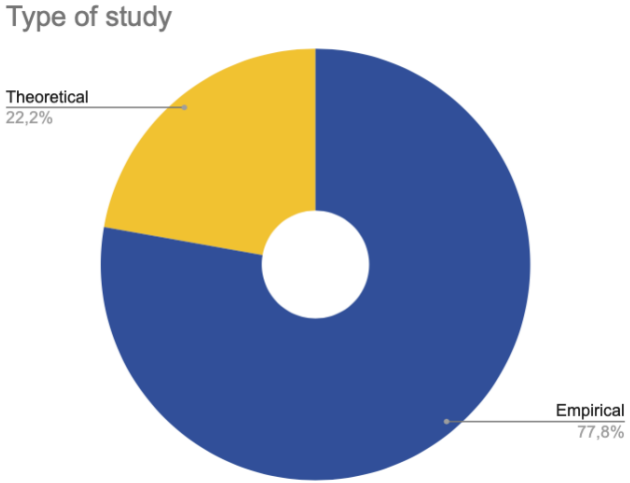
TAXONOMY

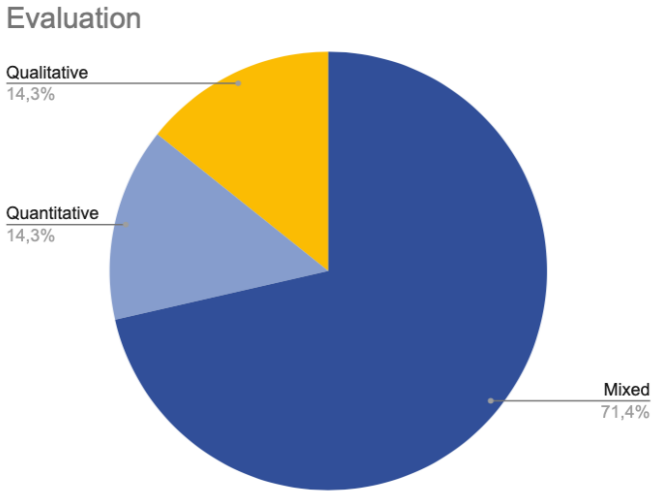
Type of study	Empirical or Theoretical
Objectives	Main objectives of the studies
Target & disability	Target audience and possible disabilities supported by the study
Type of product	Software, Cyber-physical system, theoretical framework etc.
Methodology	Development methodology, internal project management, team collaboration, documentation, versioning
Developmental framework	Frameworks, libraries and packages to simplify product development
Evaluation	Quantitative and/or qualitative analysis

RESULTS

Type of study & Evaluation

Theoretical studies >20%

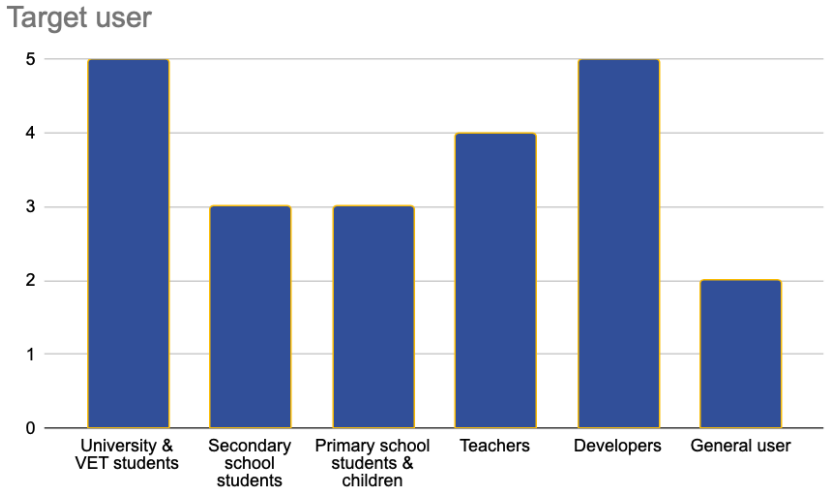




Mixed approach >70%

RESULTS

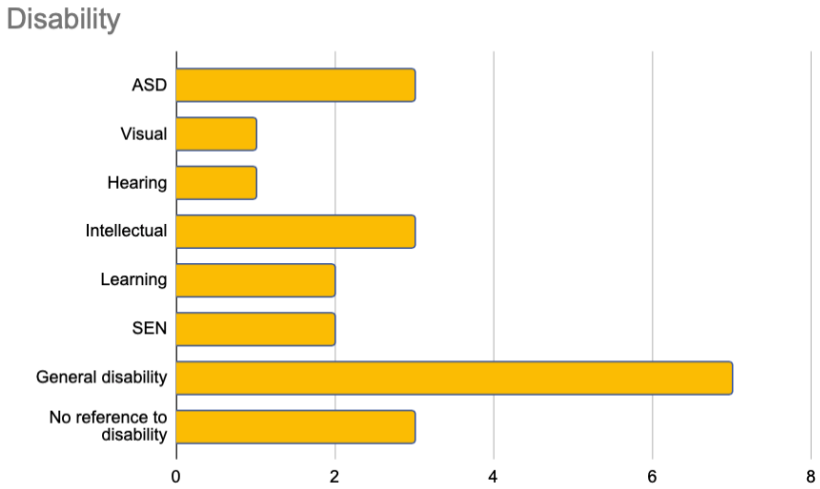
Target user & Disability



5 studies: adult learners, including:

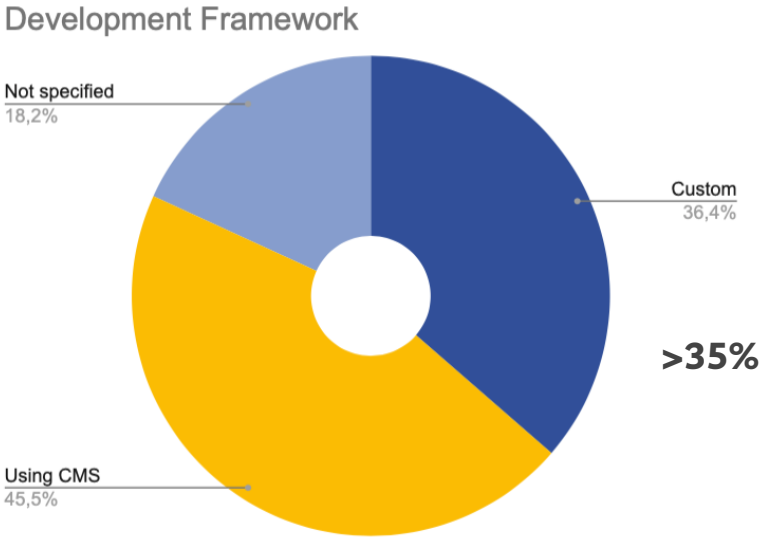
- **2 studies**: no reference to disability
- **3 studies**: related to VI, HI, ASD

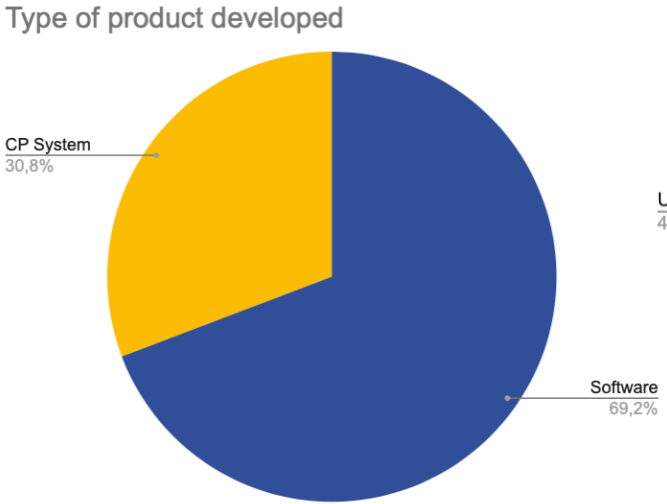
Many studies vaguely refer to a **general disability** or do not implement features for users with disabilities



RESULTS

Type of product & Development framework



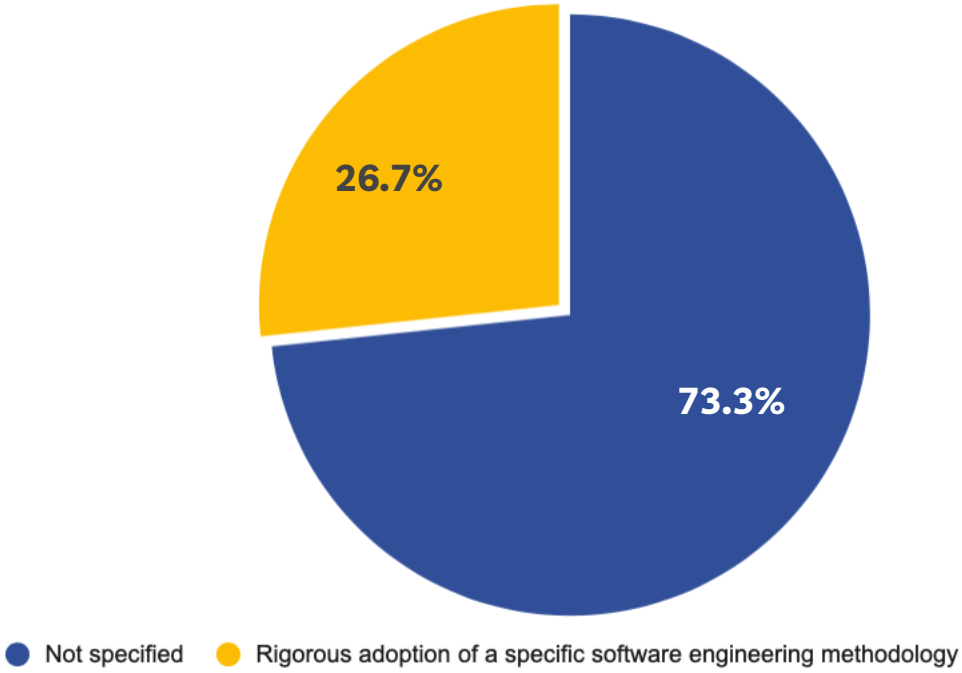


>35% of developers dedicated to full development using **Unity 3D**

>45% of people who have created digital material using an **existing CMS**

RESULTS

Methodology



Involvement of an interdisciplinary team, focus-group, brainstorming sessions, user tests etc.

but

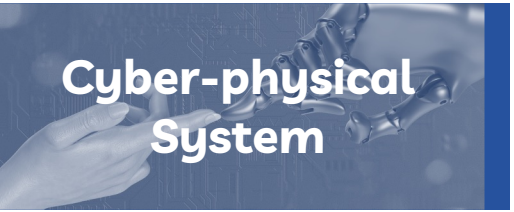
lack of **consolidated methodology**

Methodological and theoretical foundation

is essential when we have to meet the needs of all and apply the solution in other contexts

RESULTS

Objectives



Head-Mounted Displays to create

AR or VR simulations

AR books or AR mobile apps

marker based

- To increase motivation and capture the user's attention through gamification **(all of them)**
- To facilitate the learning of academic skills **(N° 9)**
- To facilitate the acquisition of skills related to daily life **(N° 2)**

Researches, methodological proposals, theoretical frameworks

- To support developers, educators and teachers in the realisation of technological products
- To promote an educational approach based on immersive technologies

Main ISSUES

HIGH COST

To implement these technologies

LACK OF COMPETENCE AND TRAINING

Of teaching staff, which requires time and efforts

CULTURAL BARRIERS

Doubts about the effectiveness of XR to improve student learning

PRIVACY

Related to the protection of student data

ACCESSIBILITY

Of digital content that is limited available

Poor integration of immersive technologies into the educational context

TARGET USER

Poor consideration of adult learners

PRODUCT DEVELOPED

A gap in terms of physical orientation in educational settings and understanding of emotional state and actual needs

CONSOLIDATED METHODOLOGY

No reference to a specific methodology which apply guidelines for designing immersive technologies for users with disabilities

Research GAPS

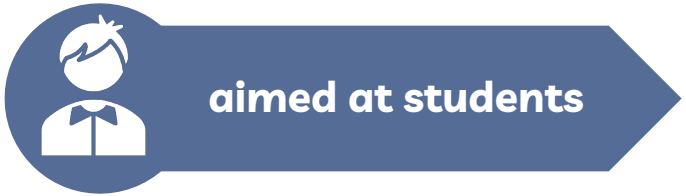
Open Research Problem

How we can realise a technological product that meets the needs of **students with disability** in the **university context**?

- Methodology adaptable to various disabilities
- Adaptable guidelines to design accessible UI
- A thorough understanding of the needs and expectations of university students with disabilities

Understanding the needs

11 out of 14 studies conducted **pre-test**



- Biographical profile
- Digital profile
- The level in an academic competence

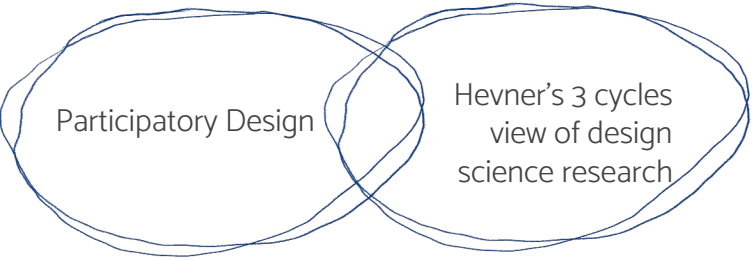
- The minimum requirements that the final product must meet

GAP: no one has asked the user about their needs

or tried to understand them based on physiological data

What we can do right now

Use a **Methodology** that incorporate



Biometric sensors to measure physiological parameters

To understand the anxieties, expectations and state of mind of students in the university environment

Using a data collection strategy to collect:

- Quantitative data
- Qualitative data

Targeted questionnaires

How do you create accessible and motivating questionnaires for this target group?

- **Focus group with an interdisciplinary team**
- **Different versions of the questionnaire**

Final result

a product that has a significant impact on the target group by giving space to their voice

Right to education

Lots of international treaties and essential for the realisation of other human rights

Inclusion of people with disabilities

A key-point of the UN 2030 agenda and education, using UDL, is crucial to reach this goal.

Goal

To demonstrate how immersive technologies can help achieve this

CONCLUSIONS

THANK YOU
for your attention