Learn More About 360 Video, VR, AR, MR & Metaverse for Education

IMMERSIVE LEARNING BRIEFING SESSION

ELN3 itsc 學能提升研究中心 Centre for Learning Enhancement And Research

Content

① Introduction

② **Five** aspects of each immersive learning experience

- Characteristics
- Examples
- Strengths
- Constraints
- Development Process

③ Summary

- Final Output Comparison
- Development Cost Comparison

Introduction

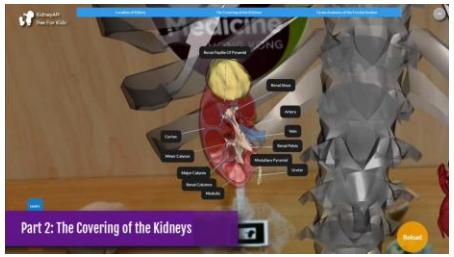
"**Immersion** is a psychological state characterized by perceiving oneself to be enveloped by, included in, and interacting with an environment that provides a continuous stream of stimuli and experiences."[1] - *Witmer & Singer*

Introduction [continued]

- There are different emerging technologies for creating immersive learning experiences to **engage students**
- Two technological variables contributing to high level of immersion - *Dengel*:
  - Vividness[2] （生動/栩栩如生, Representational richness of the environment in both breadth and depth)
  - Interactivity[2] (Speed, range and mapping of interaction)
- Nowadays, sensory fidelity or tangibility could further enhance level of immersion via different devices and technologies
  (e.g., Real-time realistic 3D rendering engine, haptic device, smell generator or spatial sound effect, etc.)
- However, it is important to understand different types of current immersive learning experience and how to make use of them to **improve our students' learning efficiency and effectiveness**

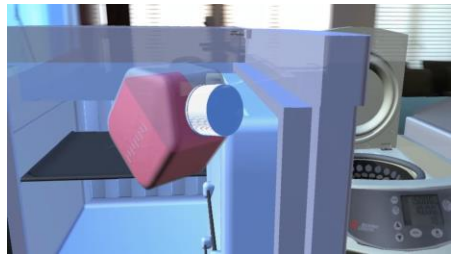
Introduction [continued]

Immersive video



AR app

VR app



MR app

Virtual space

- Five Aspects:
  - **(A)** Characteristics | **(B)** Examples | **(C)** Strengths | **(D)** Constraints | **(E)** Development Process

FIVE ASPECTS OF @ IMMERSIVE LEARNING EXPERIENCE

Characteristics, strengths, constraints, examples and development process

Immersive Video (aka 360-degree video)

Characteristics

- Viewers can view the video in different angle with an immersive feeling
- Interactive content and embedded media (texts, images, videos) can be added
- Suitable for virtual site-visit and demonstration
  - Facilities or location visit
  - Heritage or tourist attractions tour
  - 1st / 3rd person prospective video

Immersive Video [continued]

Example: Virtual site visit at the inpatient pharmacy in Queen Mary Hospital

Immersive Video [continued]

Strengths

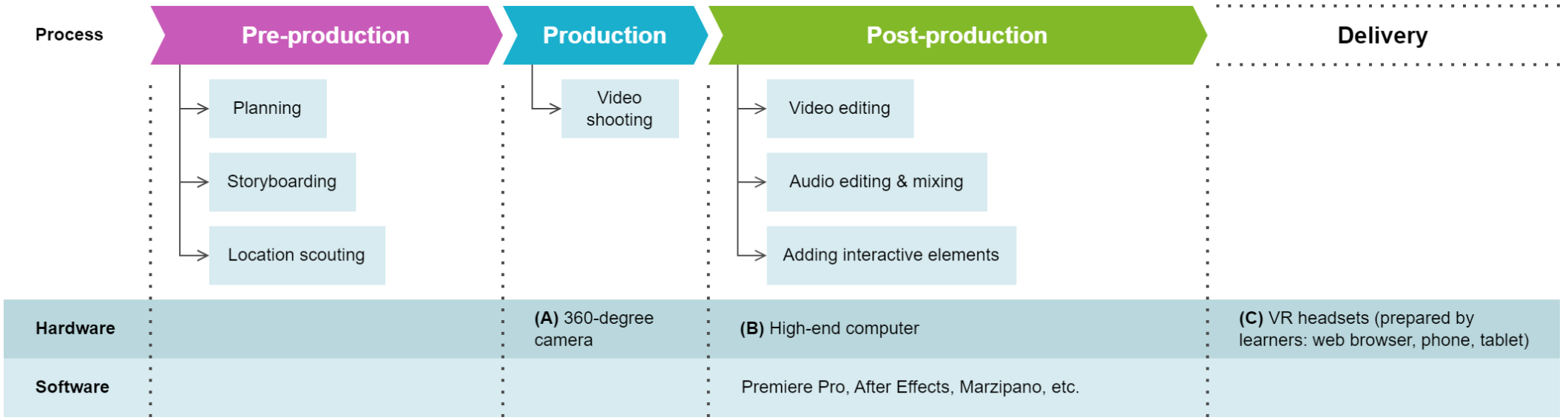
- ✓ Much reasonable cost
- ✓ Able to capture real environment or situations
- ✓ Easy to delivery in different device/ OS
- ✓ High accessibility

Constraints

- ✗ Highly depend on availability of target venue or location (i.e. need more preparation time)
- ✗ Limited Interaction compares to other emerging technologies
- ✗ Unable to change position around inside the video although able to change the viewing angle
- ✗ Unable to interact with objects in video
- ✗ Linear content delivery in a fixed sequence or paths

Immersive Video [continued]

Development process



Augmented Reality App

What is augmented reality (AR)?

“Computer-generated imagery overlaid on the real environment”[3]

AR App [continued]

Characteristics

- Usually deployed on mobile, tablet, laptop and desktop
- Virtual elements overlay in the physical object or surroundings
- Suitable for 3D visualization, e.g.
  - Interior or fashion design
  - Exhibition/ Museum Guided Tour
  - Human anatomy

AR App [continued]

Example: KidneyAR

AR game [continued]

Example: Cranial AR Teaching

AR App [continued]

Strengths

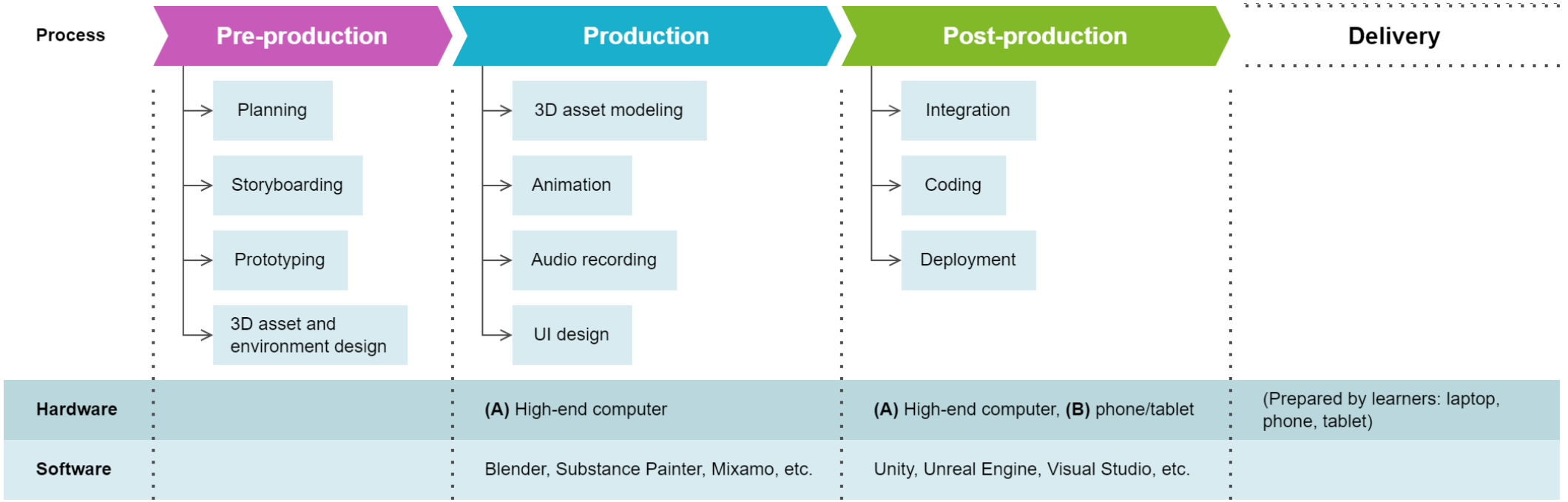
- ✓ High mobility
- ✓ Easy to delivery in different device
- ✓ High accessibility
- ✓ Custom game rules (e.g. levels, missions, scores)
- ✓ Generally, only small space is needed (e.g., a surface of table)

Constraints

- ✗ Games are not interconnected
- ✗ Limited interaction
- ✗ Long development time

AR App [continued]

Development process



Virtual Reality App

What is virtual reality (VR)?

“An immersive experience in a completely computer-generated environment”[3]

VR App [continued]

Characteristics

- VR headset (aka Head Mounted Display | HMD) required
  - App base (IOS/ Android)
  - System base (Local)
  - Single player vs multi players
- Fully immersive experience by placing user in a specific virtual environment
- Suitable for procedural task training involving specific setting and physical interaction, e.g.
  - Medical procedures
  - Machine operation
  - Fire escape

System base (Local)

App base (IOS/ Android)

VR App [continued]

Example: Animal handling game

VR App [continued]

Vividness | ★★★★★
Interactivity | ★★★★★

Strengths

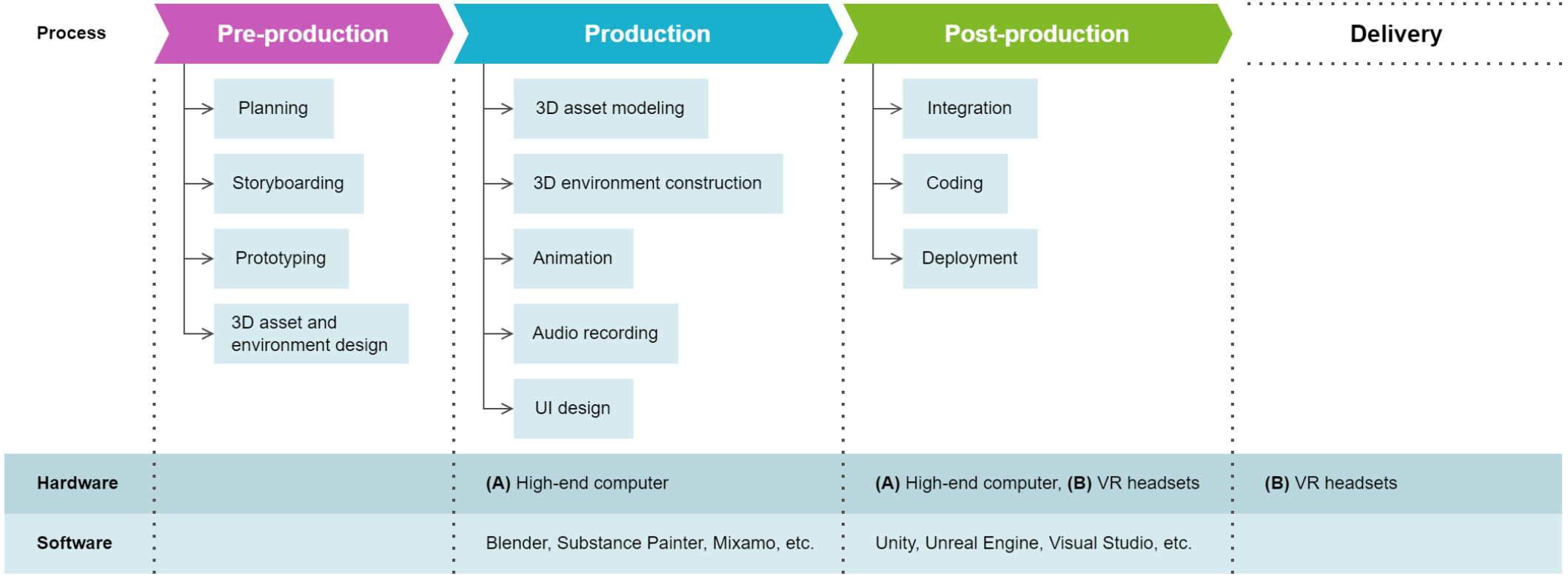
- ✓ Highly customizable 3D graphics
- ✓ Wide range of interactions possible
- ✓ High Interaction
- ✓ Custom game play (e.g. levels, missions, scores)

Constraints

- ✗ Low flexibility in terms of device and platform
- ✗ Very long development time
- ✗ Lots of programming tasks and testing are involved
- ✗ Need sufficient space

VR App [continued]

Development process



Mixed Reality App

What is mixed reality (MR)?

“Computer-generated imagery merged with the real environment that the user can **interact** with”[3]

MR App [continued]

Characteristics

- Mixed reality headset like HoloLens required
- Interaction possible between user, virtual elements and real-world elements
- Suitable for procedural training requiring real-world environment, e.g.
  - Real machine operation with virtual instructions
  - Lab procedures
  - Graffiti

MR App [continued]

Example : Mixed reality laboratory

MR App [continued]

Vividness | ★★★★☆
Interactivity | ★★★★★

Strengths

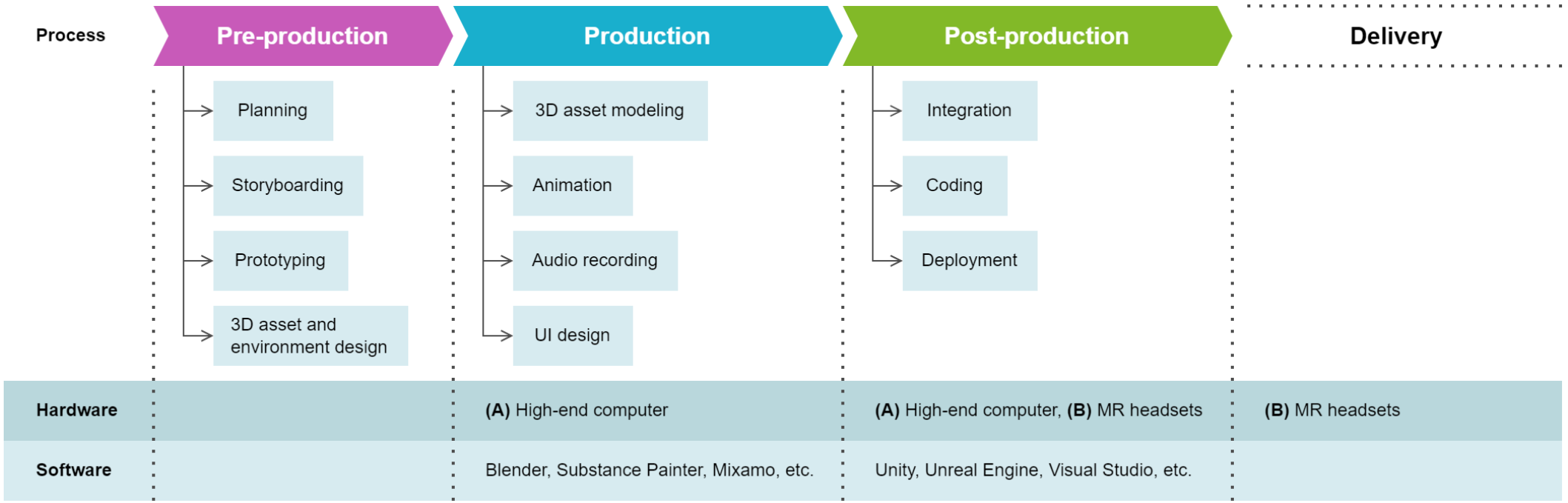
- ✓ High interactivity compared to AR game
- ✓ Blended with realistic environment
- ✓ Custom game rules (e.g. levels, missions, scores)

Constraints

- ✗ High hardware cost
- ✗ Low flexibility in terms of device and platform
- ✗ Long development time
- ✗ Lots of programming tasks and testing are involved
- ✗ Need sufficient space or specific location (sometimes)

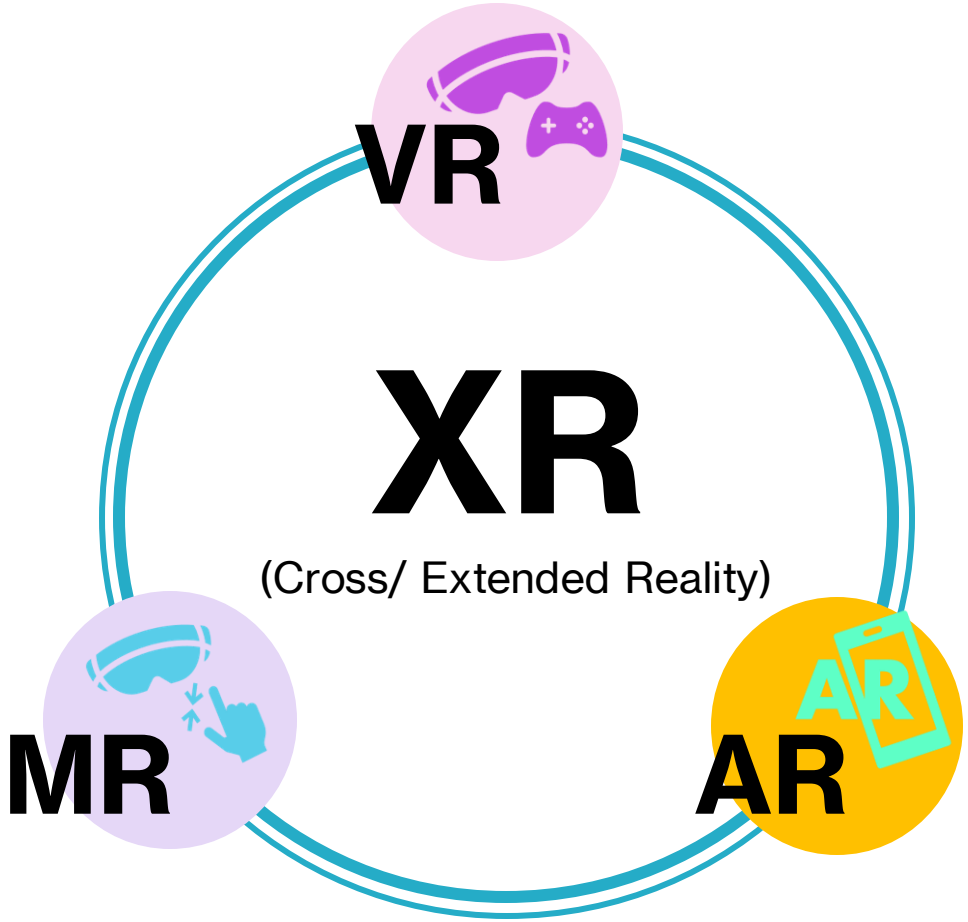
MR App [continued]

Development process



XR (Cross/ Extended Reality)

- Crisscrossing realities with vibrant, high-resolution XR passthrough.
- Using your hands - Navigate, click, drag, scroll, and type with natural hand and finger movements.
- Glasses-free.
- Battery - Hot-swappable and replaceable.



Virtual Space (aka Metaverse)

What is the metaverse?

- A concept with diverse, ambiguous definitions
- "A three-dimensional **virtual world** inhabited by **avatars** of real people" [5]
- Current state of metaverse: social platforms containing user-created virtual environments

Virtual Space

- Collection of virtual environments
- Interactions and device compatibility: depend on platform

VS

XR App

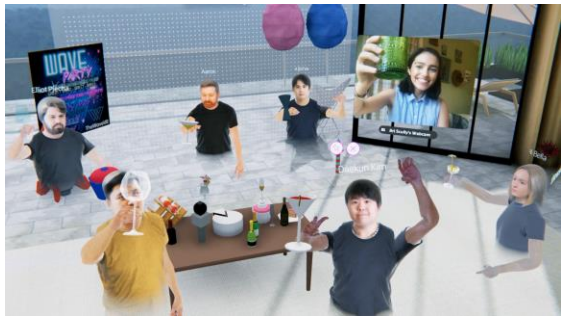
- Independent experiences
- Interactions and device compatibility: customizable

Virtual Space [continued]

Characteristics

- Focuses on Peer-to-Peer interaction
- Common built-in features
  - Avatars
  - Voice chat
  - Face camera
  - Emotes
  - Screen sharing
  - Media sharing (images, videos)
  - File sharing (Word, Excel, PPT, PDF)

Virtual Space [continued]



Spatial

Roblox

Rec Room

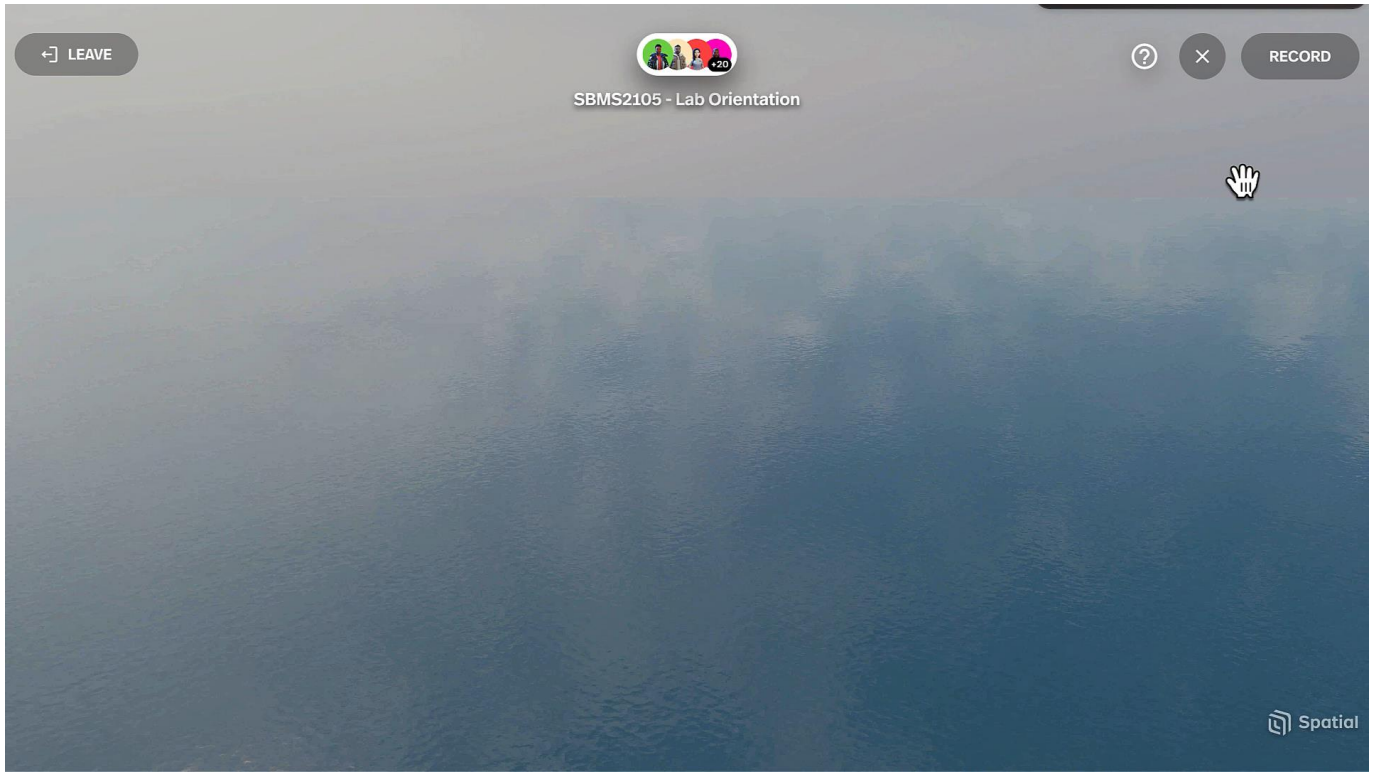
Horizon Worlds

Characteristics

- Suitable for hosting online events with large number of participants
  - Exhibition
  - Seminar/lecture
  - Discussion
  - Social gathering

Virtual Space [continued]

Example : Floor plan design exhibition on Spatial



Virtual Space [continued]

Vividness | ★★★★☆
Interactivity | ★★★☆☆

Strengths

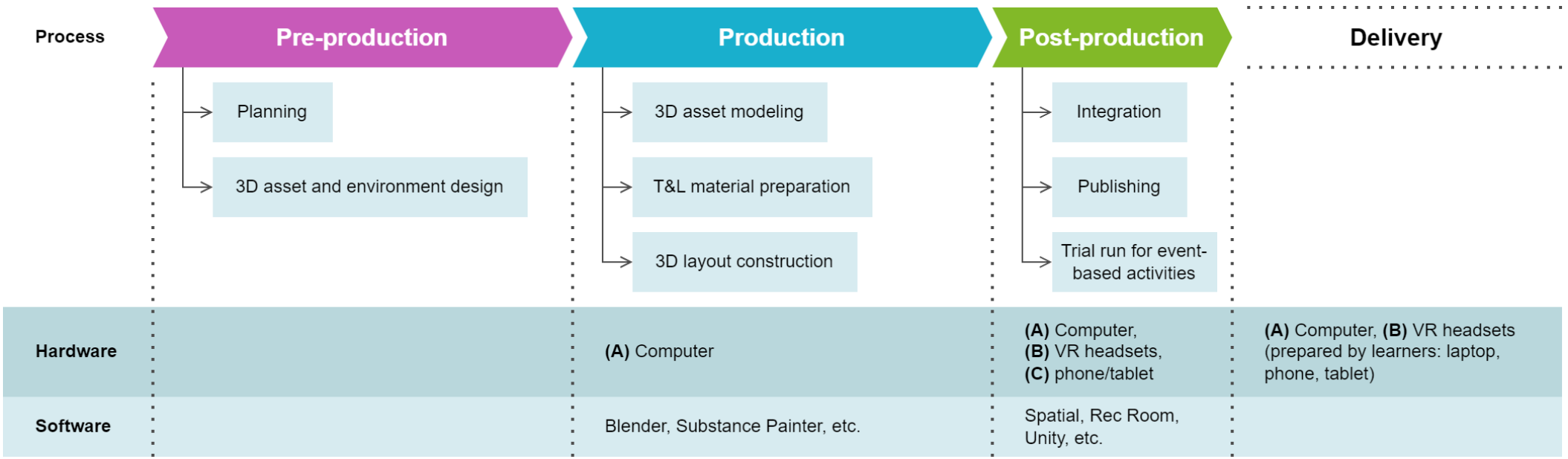
- ✓ Highly flexible in terms of device and platform
- ✓ Fast and Easy delivery
- ✓ High accessibility
- ✓ Short development time
  (e.g. use 3D Environment template)
- ✓ Different communication channels in the platform
  (e.g., text chat, voice, emoji, ... etc.)
- ✓ Support large group of learners simultaneously

Constraints

- ✗ Limited and non-customizable interaction with virtual objects or game rules
- ✗ No custom UI

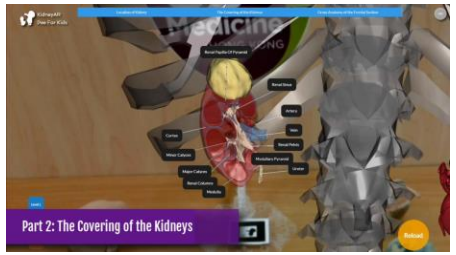
Virtual Space [continued]

Development process



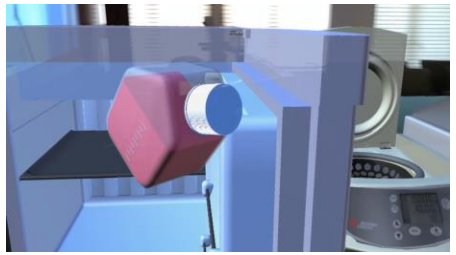
Summary

Immersive video



AR app

VR app



MR app

Virtual space

VR system-based

App-based
(IOS/ Android)

Summary [continued]

Final Output Comparison

	Vividness	Interactivity	Delivery/ Accessibility	Ease of use for learners
Immersive Video 	★★	★★	★★★★★	★★★★★
AR App 	★★★	★★★	★★★	★★★★
VR System-based 	★★★★★	★★★★★	★	★★★
VR App-based 	★★★★★	★★★★	★★★	★★★★
MR App 	★★★★	★★★★★	★	★★
Virtual Space 	★★★★	★★★	★★★★★	★★★★

Summary [continued]

Development Cost Comparison

	Time	Hardware cost	Software cost
Immersive Video 	Medium	Medium	Vary*
AR App 	High	Medium	Vary*
VR System base 	High	High or Vary*	Vary*
VR App base 	High	Low	Vary*
MR App 	Very High	Very High	Vary*
Virtual Space 	Medium	Low	Vary*

* The software & hardware cost may depend on different factors like specific required features and the timeline of the project. However, there are numerous free tools on the market.

Summary

- Currently, there is no perfect solution for immersive learning
- Each type of experience has its characteristics, strengths and constraints
- The type of learning experience should be picked based on the learning objectives, so we can
  - Enhance the efficiency and effectiveness of learning and teaching
  - Meet the learning style or needs of students
  - Improve user-accessibility and time flexibility to engage learners

- Feel free to tell us your ideas. **We are here to help!**

Let's

CUHK 2025 | Education Strategic Plan

"Meeting the Challenges of Tomorrow"

THANK YOU

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