

The background of the slide features a nighttime cityscape with numerous skyscrapers and illuminated windows. Overlaid on this image is a grid of binary digits (0s and 1s) that appear to be falling or streaming down from the top right towards the bottom left, suggesting a digital or metaverse theme.

When educators meet the metaverse: An overview and challenges

Lik-Hang Lee, PhD

Assistant Professor with Graduate School of Data Science

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Lik Hang Lee
www.lhlee.com



HKU

B.Eng. (Hons)
Logistics Eng. & Supply Chain Mgt.
2008 - 2011



HKU

M.Phil.
Industrial & Manufacturing Sys. Eng. 2011 -
2013



HKUST

Ph.D.
Computer Science and Engineering
2015 - 2019



Uni. Oulu

Postdoc
Center for Ubiquitous Computing
2019 - 2020

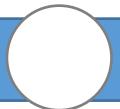


KAIST

Assistant Professor
2021 - now

Academic &
Research

Industry



Distribution Systems
Analyst
2014 - 2015



AVA TECH
Avatech Innovation Limited

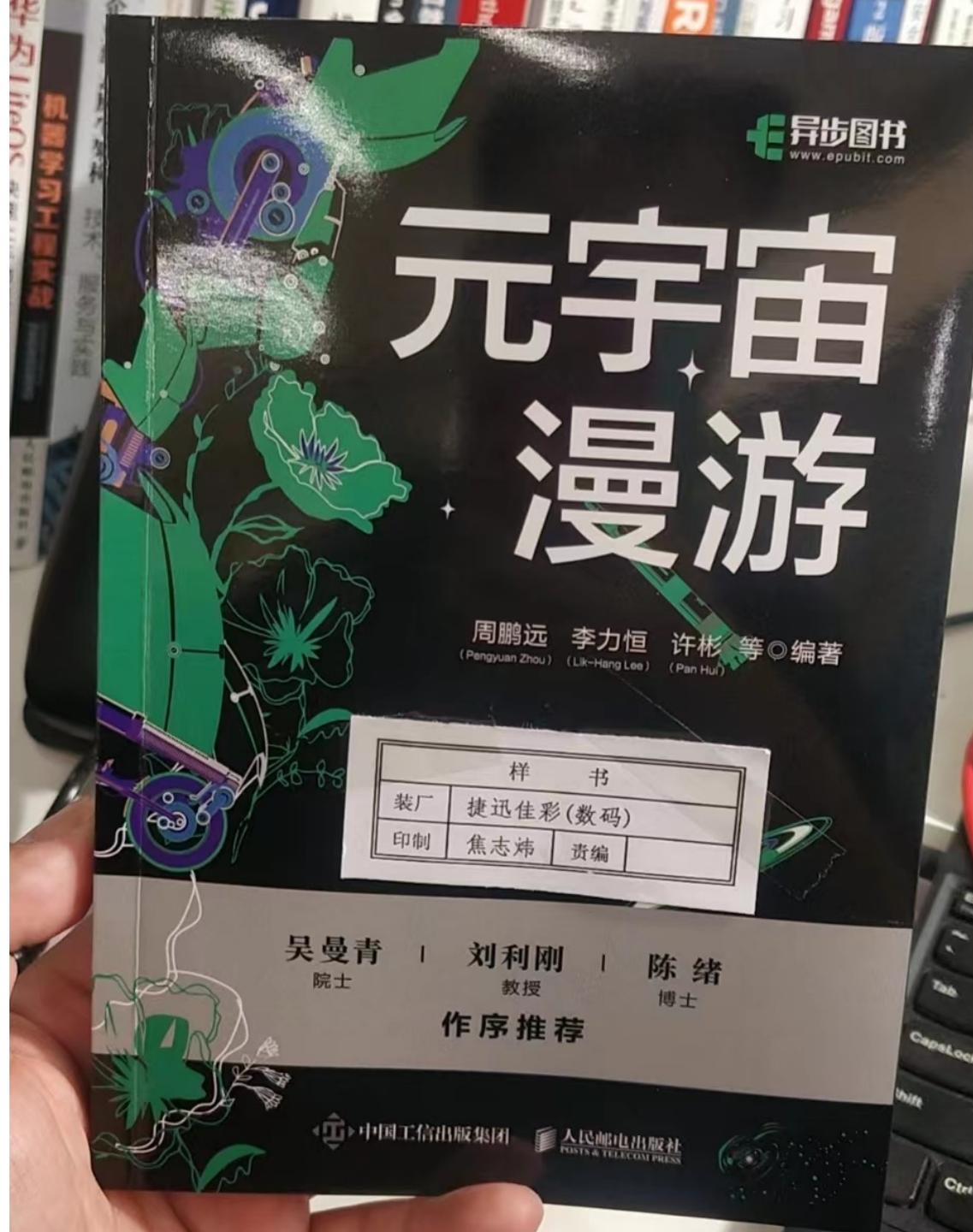


AVA TECH
Avatech Innovation Limited

Non-executive Director
2020 - Now



Book
Author:
Lik Hang,
LEE
(李力恒)



Media Coverage (recent months)

RTHK-HK
香港電台

TV RADIO NEWS WEB+ ARCHIVE APPS OURTHK 繁/简

All Episodes SPECIAL WEBSITE PODCASTS

十萬八千里

Presenters: 許永康、陳宇光、黃曉玲
監製: 陳宇光

新聞裡，有知識，六十分鐘走遍世界，每週陪您漫遊《十萬八千里》，
主要環節：人文足印、黑腳雲霧、一日千里

15/01/2022

祖高域澳洲簽證風波、喀麥隆舉辦非洲國家盃

主持: 許永康、黃曉玲

15/01/2022 - 足本 Full (HKT 11:04 - 12:00)

15/01/2022 - 祖高域澳洲簽證風波、喀麥隆舉辦非洲國家盃

專題討論: 元宇宙
嘉賓: 韓國科學技術院(KAIST)工業及系統工程學系助理教授李力恒

所有集數

普出校園精彩

元宇宙與網絡安全

主持人: 鄭敏兒

校園資訊站-多媒體Corner (元宇宙與網絡安全)
嘉賓: 韓國科學技術院 助理教授 李力恒博士

更多...

26/03/2022 - 足本 Full (HKT 17:05 - 18:00)

香港電台 RTHK AM621 & FM926

香港經濟日報 HKEJ

香港明報 Mingpao HK



Media Coverage (recent months)

KAIST | NEWS

people

Start date End date

Professor Lik-Hang Lee Offers Metaverse Course for Hong Kong Productivity Council

View : 229 | Date : 2022-04-06 | Writer : PR Office

A photograph of Professor Lik-Hang Lee, a man with dark hair and glasses, wearing a dark blue suit and a red tie. He is smiling and holding a VR headset in his hands, showing it towards the camera. The background shows shelves with various items in what appears to be an office or laboratory setting.

< Professor Lik-Hang Lee >

Professor Lik-Hang Lee from the Department of Industrial System Engineering will offer a metaverse course in partnership with the Hong Kong Productivity Council (HKPC) from the Spring 2022 semester to Hong Kong-based professionals.

Professor Lai-Hang Lee from the Department of Industrial System Engineering will offer a metaverse course in partnership with the Hong Kong Productivity Council (HKPC) from the Spring 2022 semester to Hong Kong-based professionals.

S. Korea KAIST PR OFFICE

As things stand now, major Metaverse players and/or contenders — including Sandbox, Decentraland and the FAMGA companies — “offer very little interchange between their web platforms and other platforms,” Lik-Hang Lee, assistant professor at the Korea Advanced Institute of Science and Technology, told Cointelegraph. This lack of interoperability, characteristic of Web2, is a shortcoming that needs to be addressed if the Metaverse is to reach its full potential. This includes, at a minimum, the following elements, according to Lee:

- Anyone should be able to build a virtual world that can link to the rest of the Metaverse;
- Any device or browser should be able to access the Metaverse provided it meets with certain predetermined specifications;
- Ownership of digital assets should be recorded and preserved across multiple servers and clients;
- A single avatar should be able to communicate with avatars on other servers;
- People should have the ability to produce, show, buy and sell their digital assets within the Metaverse.

“In light of the growing number of metaverse initiatives that are incompatible with one another, it is more important than ever to build standardizing organisms,” Lee told Cointelegraph.



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Exchange

"In light of the growing number of metaverse initiatives that are incompatible with one another, it is more important than ever to build standardizing organisms," Lee told Cointelegraph.



Canada Fairchild
Radio Group FM96.1

CONVERSATION

amic rigour, journalistic flair

metaverse, membangun kehidupan dalam dunia virtual: menjanjikan tapi juga potensial bermasalah

Wednesday, January 17, 2022 6.00am GMT



laki-laki berlari dalam dunia digital. Shutterstock (Sergey Nivens)

Pandemi COVID-19 telah memaksa dan menjadi katalisator penting dalam mengubah secara radikal aktivitas hidup manusia dari *offline* ke *online*. Sistem kerja dari rumah, webinar, dan rapat *online* yang dulu sulit terjadi, kini menjadi gaya hidup yang lazim.

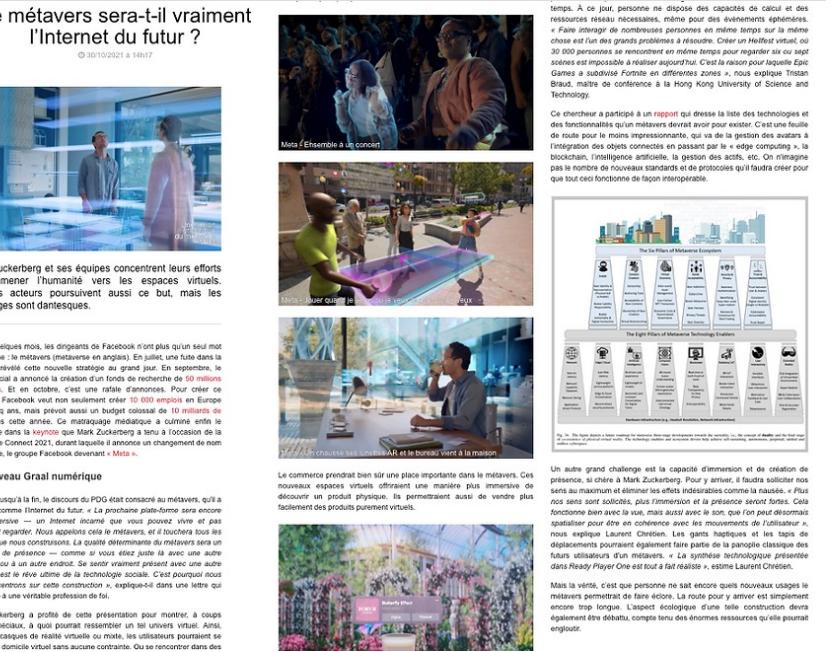
Hampir semua aktivitas tatap muka seperti rapat, sekolah, dan hiburan berubah menjadi *online*. Misalnya, film-film *box office* yang dulu tayang eksklusif di bioskop, kini beralih perlisannya secara *streaming*.

Dengan kondisi pandemi yang belum menunjukkan tanda berakhir, metaverse dapat menjadi solusi ampuh untuk alternatif kehidupan selain di dunia fisik. Metaverse diciptakan dengan memadukan berbagai unsur teknologi seperti konferensi video, media sosial, hiburan, *game*, pendidikan, pekerjaan, dan *meta-universe*.

Keunggulan inilah yang akan membuat metaverse tampil sebagai revolusi internet.

Sebuah *rise* menunjukkan metaverse memberikan manfaat signifikan dalam kehidupan manusia seperti menyediakan ruang tanpa batas kegiatan *campagne* kepresidenan 2020 Joe Biden di *Animal Crossing* Nintendo, wisuda mahasiswa

Indonesia e Conversation



ance Tech Magazine - 01Net

The image is a collage of various magazine spreads from the Sunday Hindustan Times Wknd Lifestyle section. It includes:

- A large central graphic titled "Level up: Tour the new battlegrounds of the gaming world" showing a 3D landscape with various video game characters.
- An article titled "KEEPING SCORE" with a chart showing statistics like 3.24 bn, 400 mn, 746.7 mn, etc., and a map of India.
- An article titled "WHAT CONCERNED THE INDIA E-SPORTS LEAGUE IN 2022" with a QR code.
- An article titled "Playing on ears" with a grid of food-related illustrations.
- An article titled "Head in the clouds" with a QR code.
- Smaller articles and images including "Race through the top", "Grand Theft Auto V", "Grand Theft Auto IV", "Grand Theft Auto III", "Grand Theft Auto II", "Grand Theft Auto", and "Grand Theft Auto: Vice City".

India Hindustan Times

My vision

— Metaverse, everywhere and anytime



Technical Report Full-text available

All One Needs to Know about Metaverse: A Complete Survey on Technological Singularity, Virtual Ecosystem, and Research Agenda

October 2021

DOI: [10.13140/RG.2.2.11200.05124/8](https://doi.org/10.13140/RG.2.2.11200.05124/8)

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Project: [The Planet-scale Metaverse](#)

Labs: [Pan Hui's Lab](#) · [Extended Reality and Media Lab](#) · [Extended Reality and Media \(XRIM\)](#)

Authors: Lik-Hang Lee · Tristan Braud · Pengyuan Zhou · [Show all 9 authors](#)

Research Interest Score

524.9

Citations

209

Recommendations

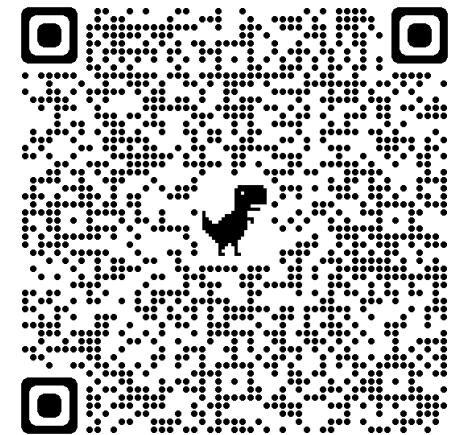
18

Reads

110,488

Since released in **mid-Oct 2021**, the average monthly reading record has been more than **110,000**.

Scan this QR code
for the full report
→



The vision of the Metaverse [1]:
“Long-lasting co-existence of virtual and physical entities, e.g., in our urban”

What is the Metaverse?

What is the Metaverse?

What is the Metaverse?

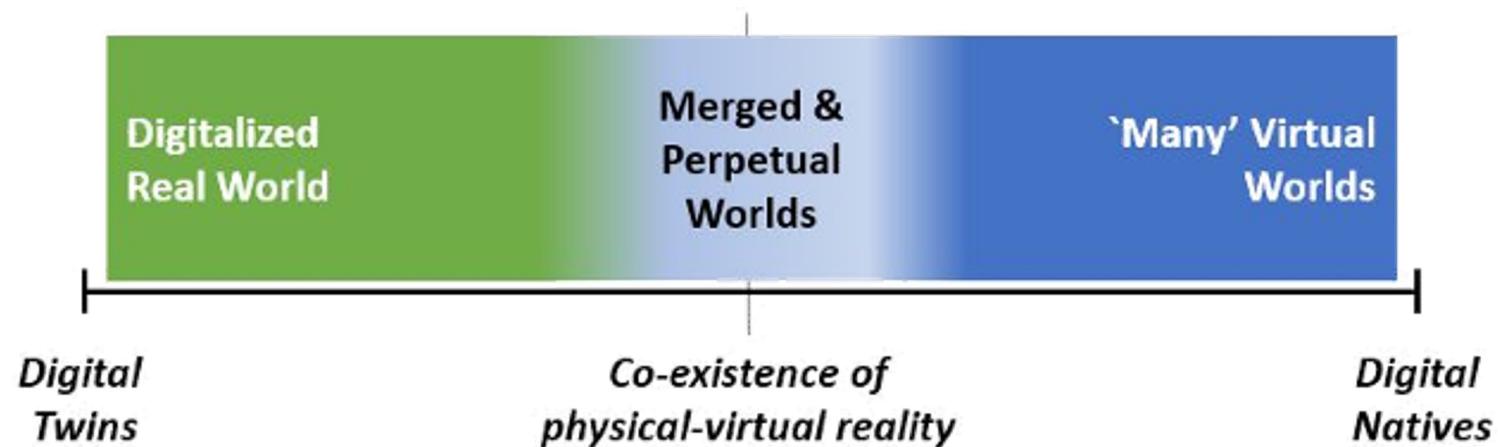
- The scene of metaverse in Snow Crash has projected the duality of the real worlds and a copy of digital environments.
- In the metaverse, all individual users own their respective avatars, in analogy to the user's physical self, to experience an alternated life in the virtuality that is a metaphor of the user's real world.



What is the Metaverse?

Three phases of the Metaverse

1. Digital Twins
2. Digital Natives
3. Co-existence of Physical-virtual Reality



What is the Metaverse?

How to build the Metaverse?



Physical World



Digital Twin



Metaverse

What is the Metaverse?

How to build the Metaverse?

Digital Twin

1. Digital Twins: a **large-scale** and **high-fidelity** digital models and entities, instead of a single object (e.g., nut and bolt), duplicated **in virtual environment**.
2. Digital Twins reflects the physical counterpart **with various properties** including the object motions, temperature, and even the functionality of such digital models and entities.
3. The connection between the virtual and physical twins is, e.g., sensors in the classroom, **tied by their data**.

What is the Metaverse?

How to build the Metaverse?

Content Creation

1. Content Creation depicts numerous content creators, perhaps represented by the avatars, which could be involved in digital creations inside **aforementioned digital worlds.**
2. Such digital creation can be **distinguishable from the physical counterpart**, or **even only exists in the digital world.**
3. Content Creation can also **produce new economic activities.**

What is the Metaverse?

How to build the Metaverse?

The metaverse

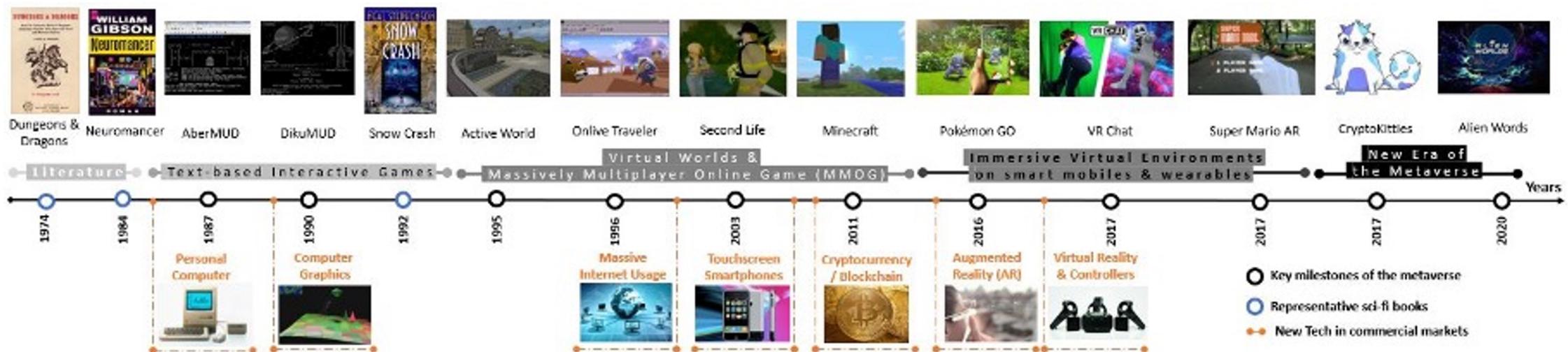
1. The metaverse could exist as a **self-sustaining** and **persistent** virtual world that co-exists and interoperates with the physical world with **a high level of independence**.
2. The avatars, or users in the physical world, can experience **heterogeneous activities in real-time** if they are in a same virtual world.
3. Theoretically, the metaverse is able to support **unlimited numbers of concurrent users** in a number of virtual worlds.

So, where are we?

So, where are we?

Metaverse Chronicle

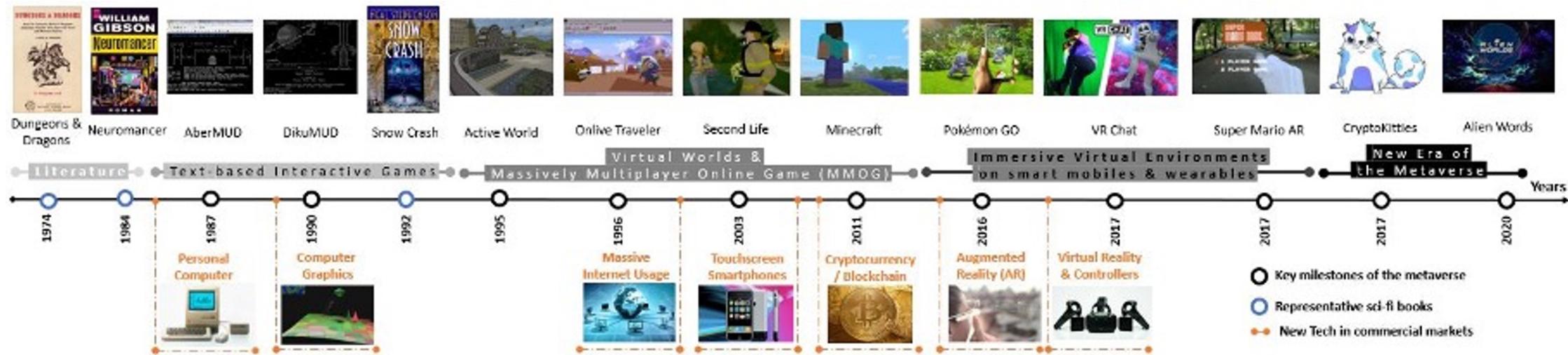
The metaverse has experienced **four transitions** from [text-based interactive games](#), [virtual open worlds](#), [Massively Multiplayer Online Game \(MMOG\)](#), immersive virtual environments on smart mobiles and wearables, to the [current status](#) of the metaverse.



So, where are we?

Metaverse Chronicle

Obviously, **technologies** serve as [the catalyst to drive such transitions](#). Nowadays, the research community is still on the way to exploring the metaverse development.



Our vision

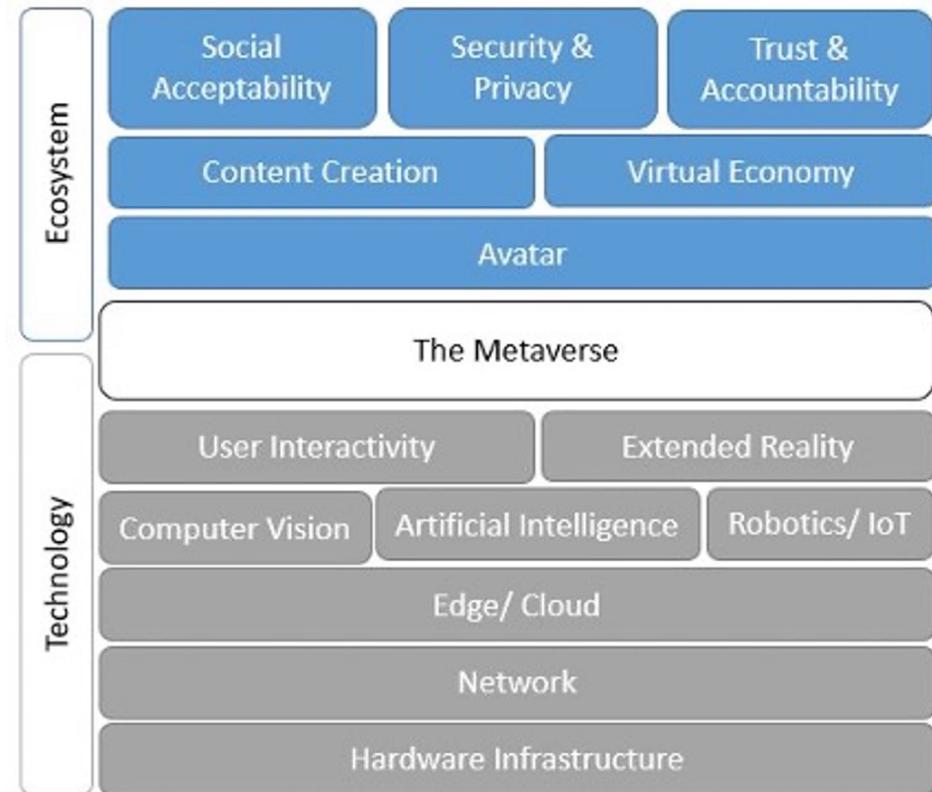
Technology and Ecosystem

Our vision

Technology and Ecosystem

A Metaverse Framework

1. Eight Core Technologies to build the Metaverse
2. Six Ecosystem issues to sustain the Metaverse



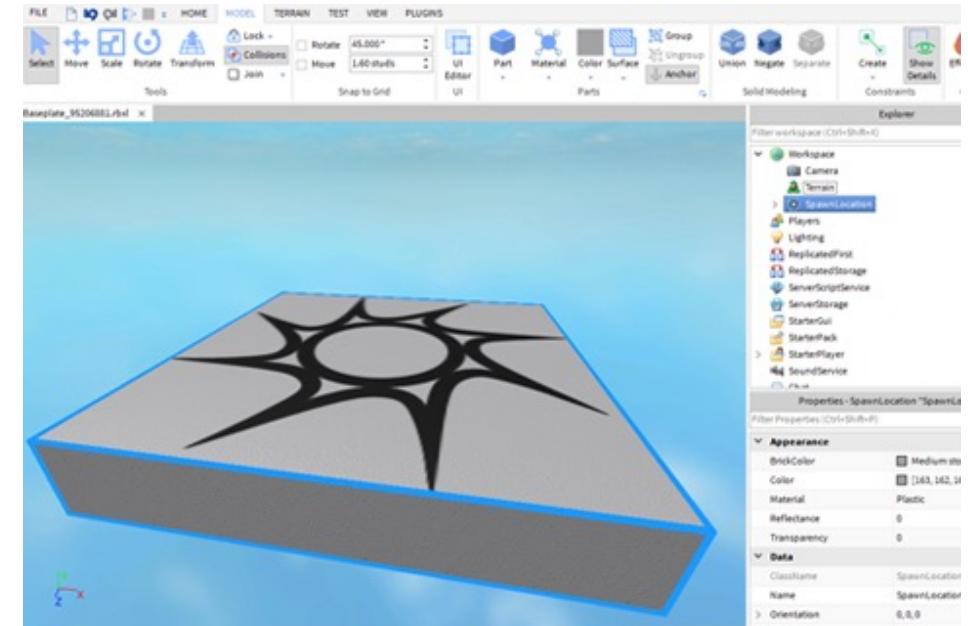
When Education meets the Metaverse...

Common Examples

When Education meets the Metaverse...

Roblox

- Roblox Studio, For game itself education,
 - boosts player creativity,
 - helps learn programming and coding skills, computing skills
- Three educational games designed for junior high school, high school and college students.
 - partner with Boston Museum of Science, content focuses on robotics, space exploration, computer science, engineering, and biomedicine.



■ IDE of Roblox Studio

When Education meets the Metaverse...

Minecraft

- Teachers can use virtual tools such as blackboards to teach in game and follow up the learning progress of students.
- Over 35 million teachers and students around the world use the educational version of Minecraft for teaching or learning.



■ Minecraft Education interface

Facebook Horizon Workrooms

- A 3D version of ZOOM meeting system
- The virtual whiteboard acts as a digital canvas, with AI tools, facilitate drawing and concept expressions, allowing team discussion in metaverse



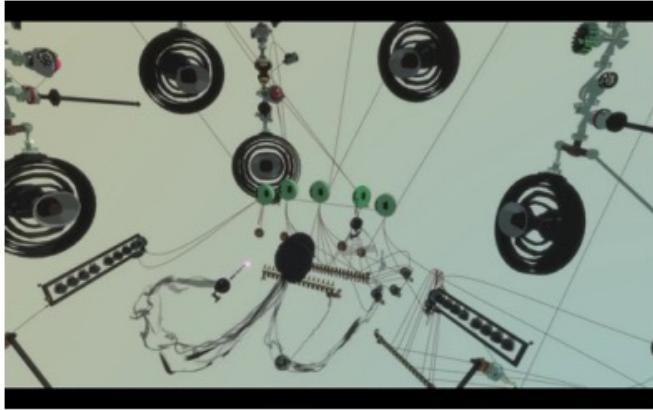
■ Facebook Horizon Workrooms

When Education meets the Metaverse...

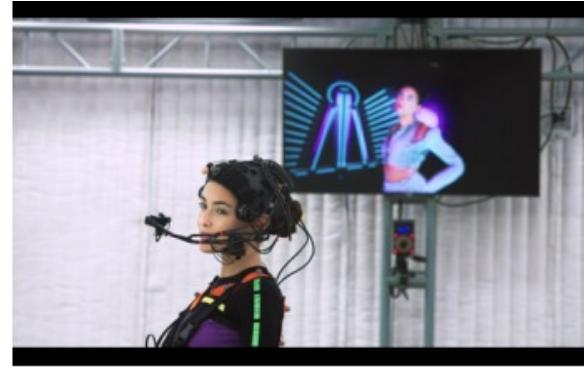
More examples: Music, Robotics, Metacampus

More examples: Music, Engineering, Robotics...

Music



(a) PatchXR, a VR musical instrument, turning a room into music studio on the fly [100].



(b) Singer Madison Beer performing in a studio, while audiences watching performance via her avatar in a virtual world [191].



(c) 360° Egocentric view of the audience watching orchestra in the virtual space [168].

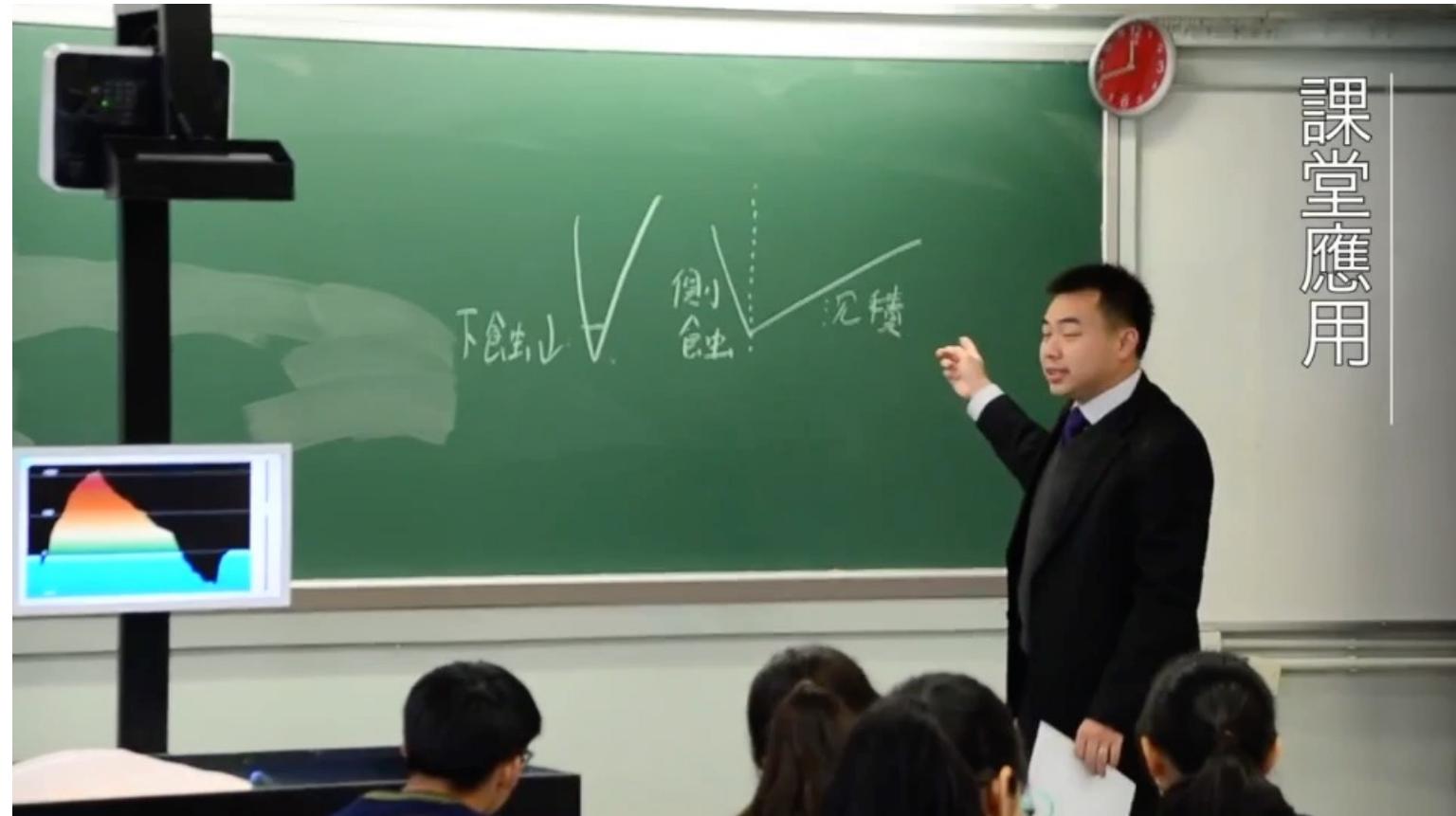
More examples: Music, Engineering, Robotics...

Engineering & Robotics

- Metaverse are good solution candidates for opening the communication channels between robots and virtual environments, due to their prominent feature of visualizing contents.
- In the metaverse, users build trust and confidence with the robots, leading to the paradigm shift towards human-robot collaboration.
- The vision of the metaverse with collaborative robots is not only limited to leveraging robots as a physical container for avatars in the real world, and also exploring design opportunities of our alternated spatial with the metaverse.
- Virtual environments in the metaverse can also become the game changer to the user perception with collaborative robots.



ARGEON Sandbox



課堂應用

功能
Function



快速啟動軟件無需任何程式背景或操作



水平線高度調校



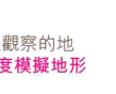
模擬等高線及高度色階可供參考



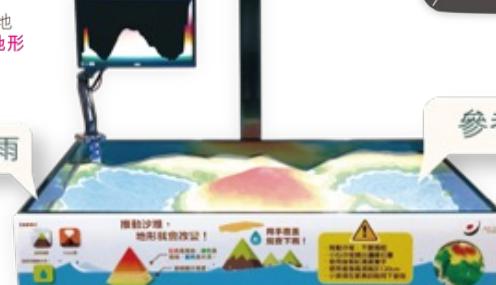
把沙盤畫面另存至USB裝置 (.png)
輸出同步影像班房投影機 (HDMI)



支援即時可供對比及觀察的地
形橫切面、立體360度模擬地形



雙顯示屏



模式
Mode



自然地貌



火山山脈



冰天雪地



黑白模式

ARGEON Sandbox



Institutions that have purchased AR-GEO



www.avatech.hk

Education Organization:

More than 170 schools in Hong Kong, Shenzhen and Macau

Such as the University of Hong Kong (HKU), the University of Macau

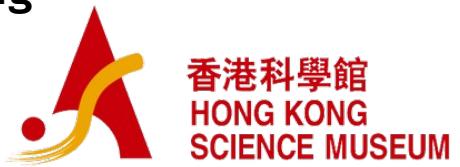


香港大學
THE UNIVERSITY OF HONG KONG



4 long-term exhibition units :

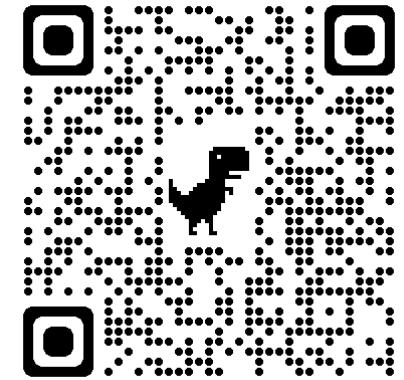
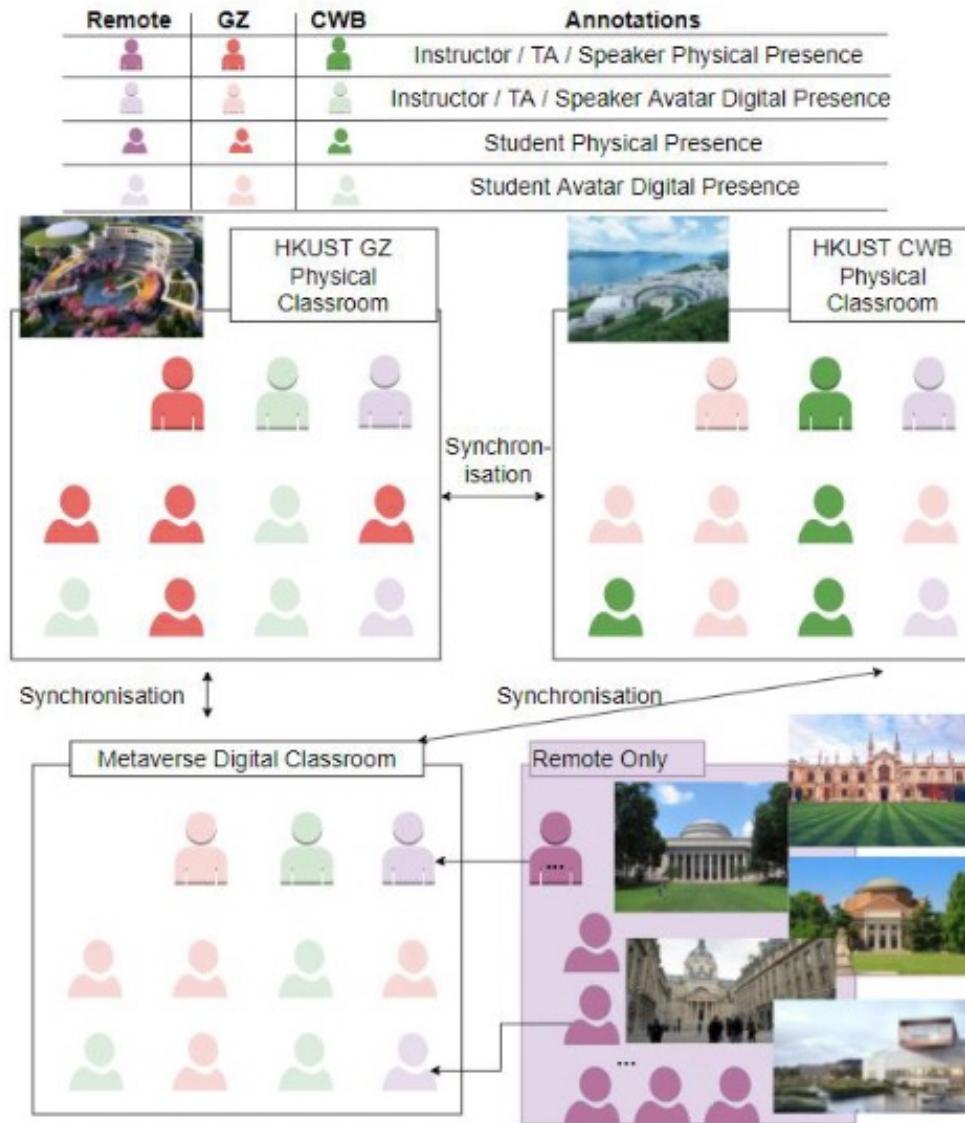
- Hong Kong Science Museum
- Ing Dang Hong Kong (2016-2018)
- The BOXES Hong Kong
- Ing Dang, Shenzhen



More examples: Metacampus

Metaverse Classroom

Virtual Classrooms Connecting
multiple Physical Campuses

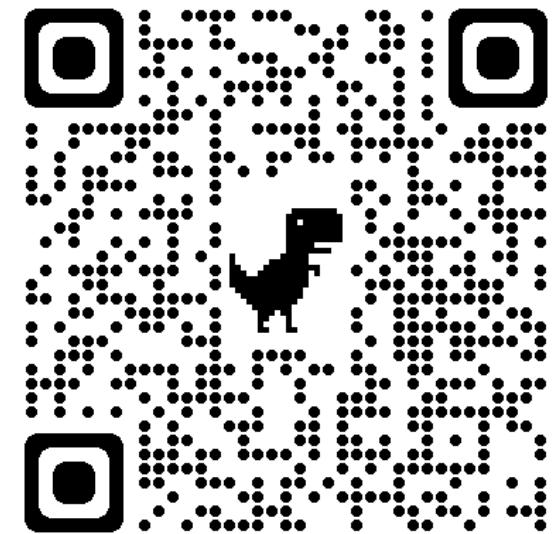
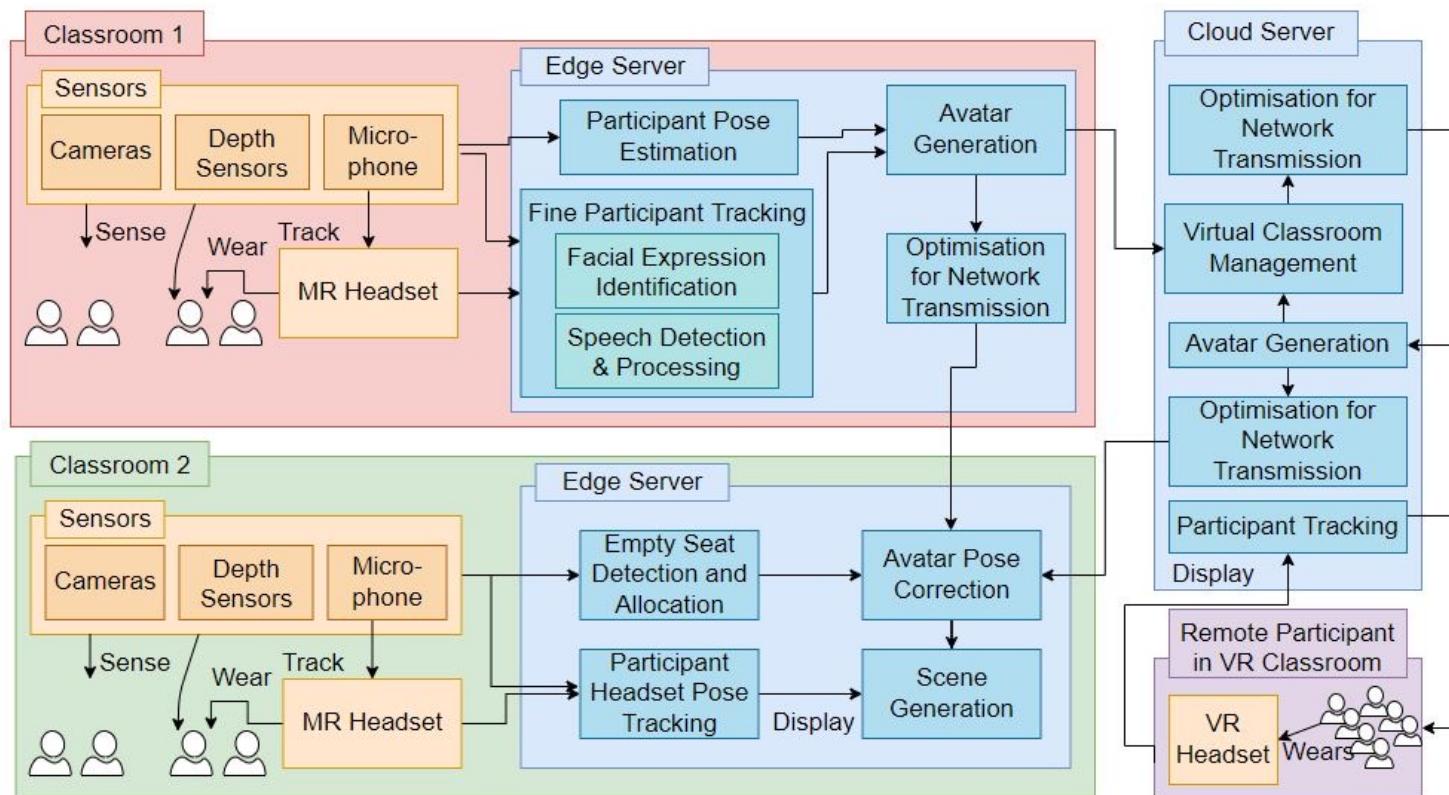


Full paper
Scan QR Code

More examples: Metacampus

Metaverse Classroom

Architecture of the Metaverse classroom



Full paper
Scan QR Code

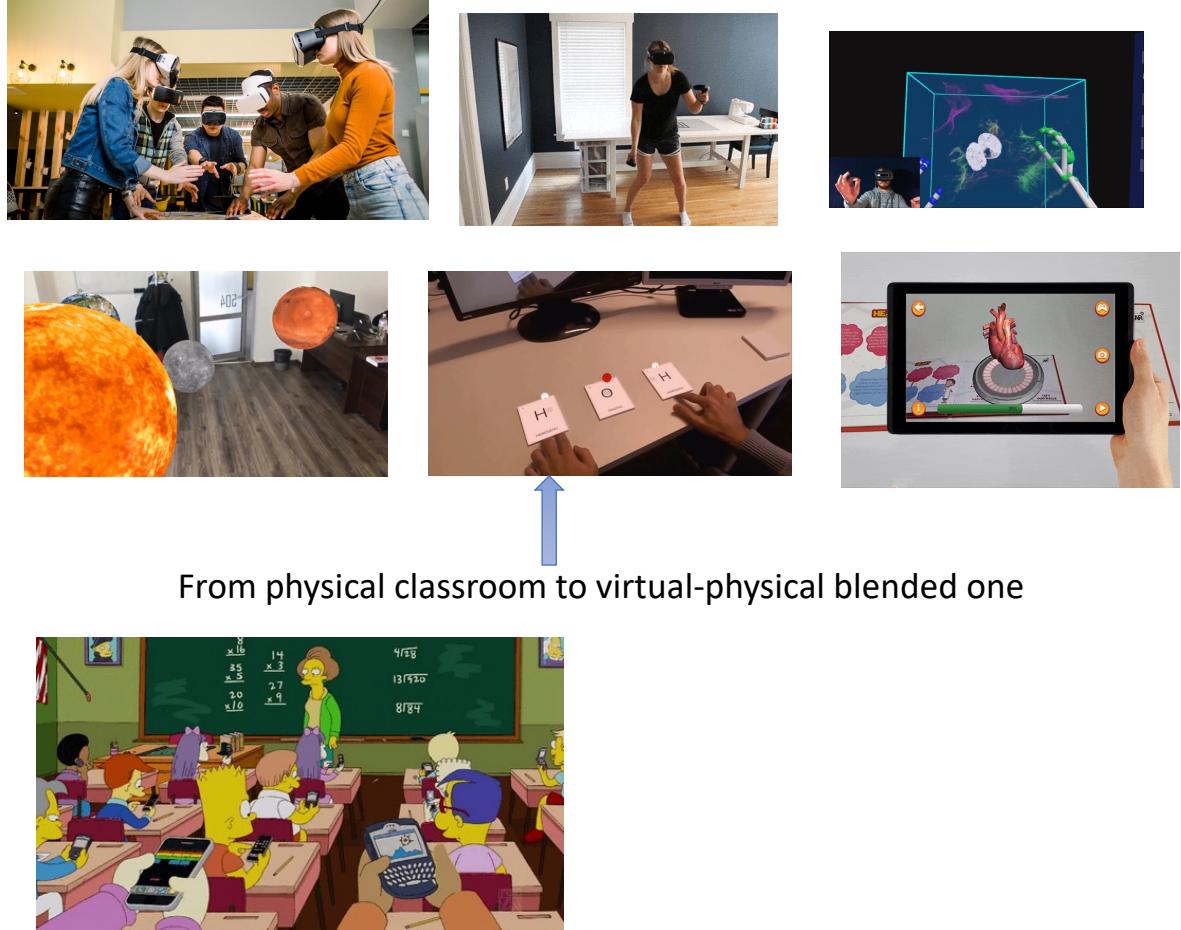
More examples: Metacampus

Metaverse Classroom

Key Features and Advantages

Our metaverse classroom will support the following:

- learner collaborations
- gamified learning and task-based modules
- learner driven activities
- access to restricted equipment

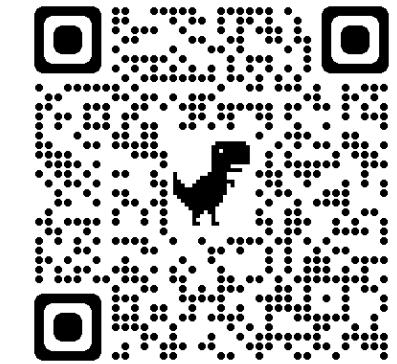
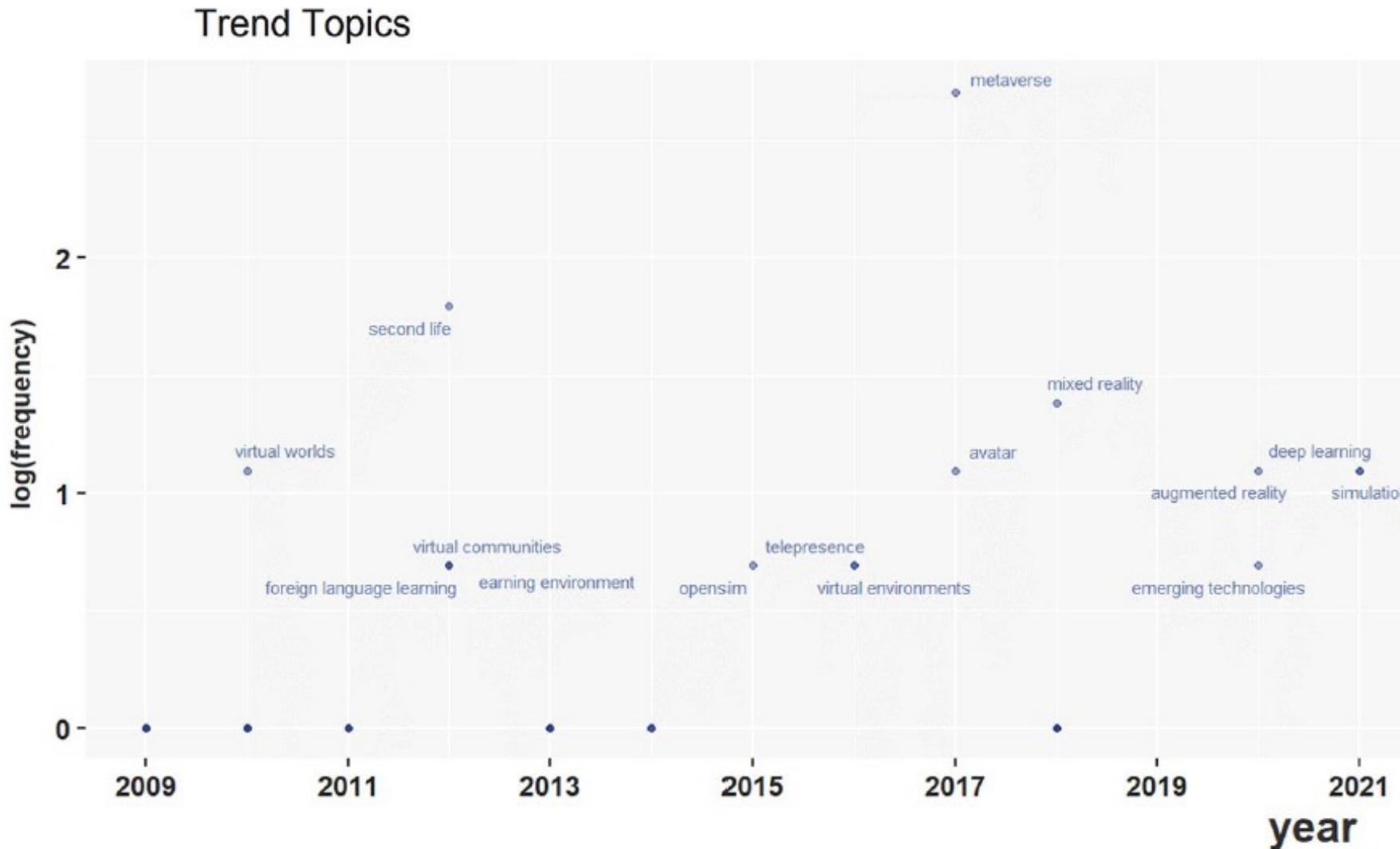


When Education meets the Metaverse...

Overview

Overview and Challenges

Distribution of Metaverse in education by topic over the years

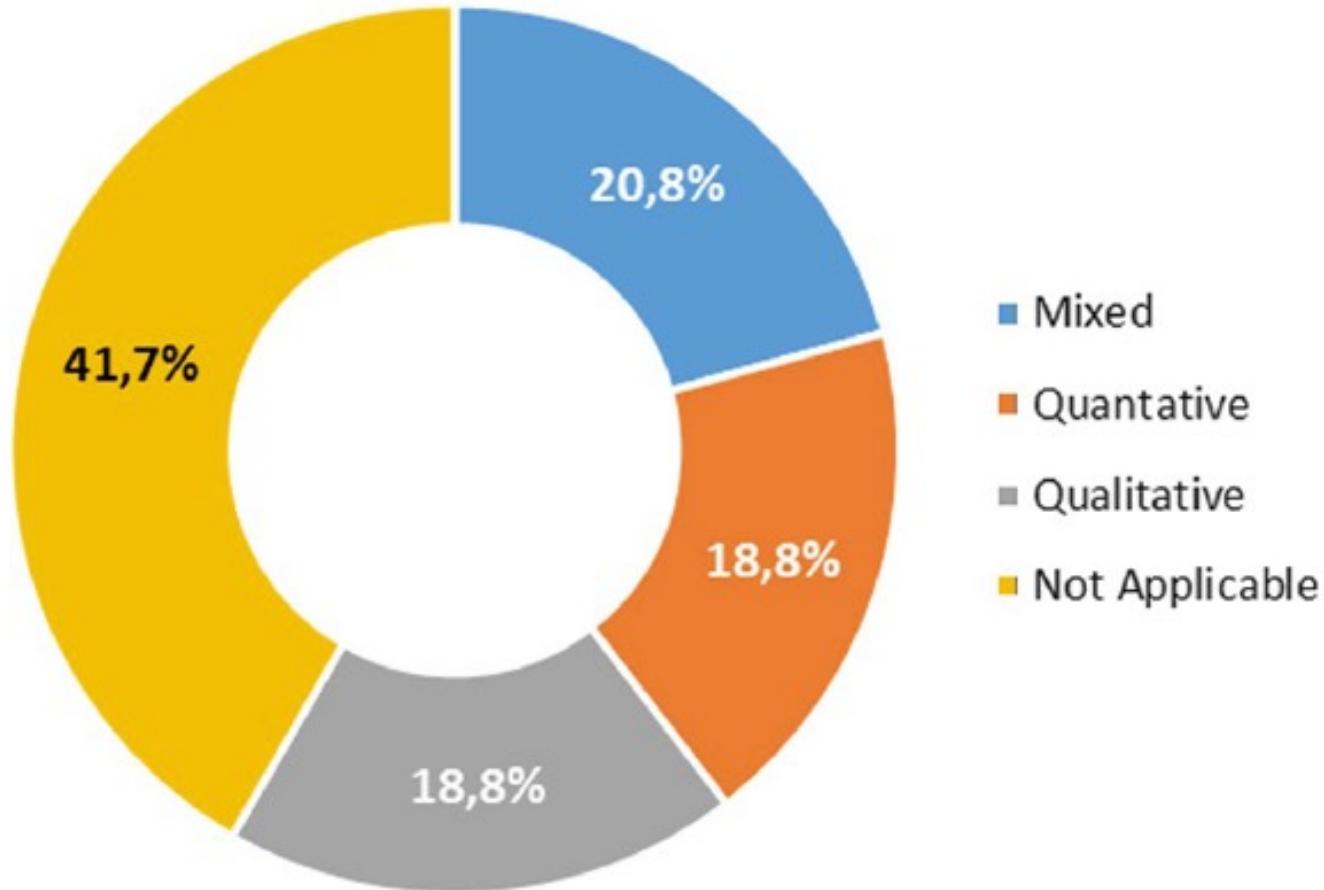


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(equal contribution) Ahmed TLILI, Ronghui HUANG, Boulus SHEHATA, Dejian LIU, Jialu ZHAO, Ahmed Hosny Saleh METWALLY, Huanhuan WANG, Mouna DENDEN, Aras BOZKURT, Lik-Hang LEE, Dogus BEYOGLU, Fahriye ALTINAY, Ramesh C. SHARMA, Zehra ALTINAY, Zhisheng LI, Jiahao LIU, Faizan AHMAD, Ying HU, Soheil SALHA, Mourad ABED, and Daniel BURGOS. Is Metaverse in education a blessing or a curse: A combined content and bibliometric analysis. Smart Learning Environments.

Overview and Challenges

Distribution of research methods in Metaverse in education studies

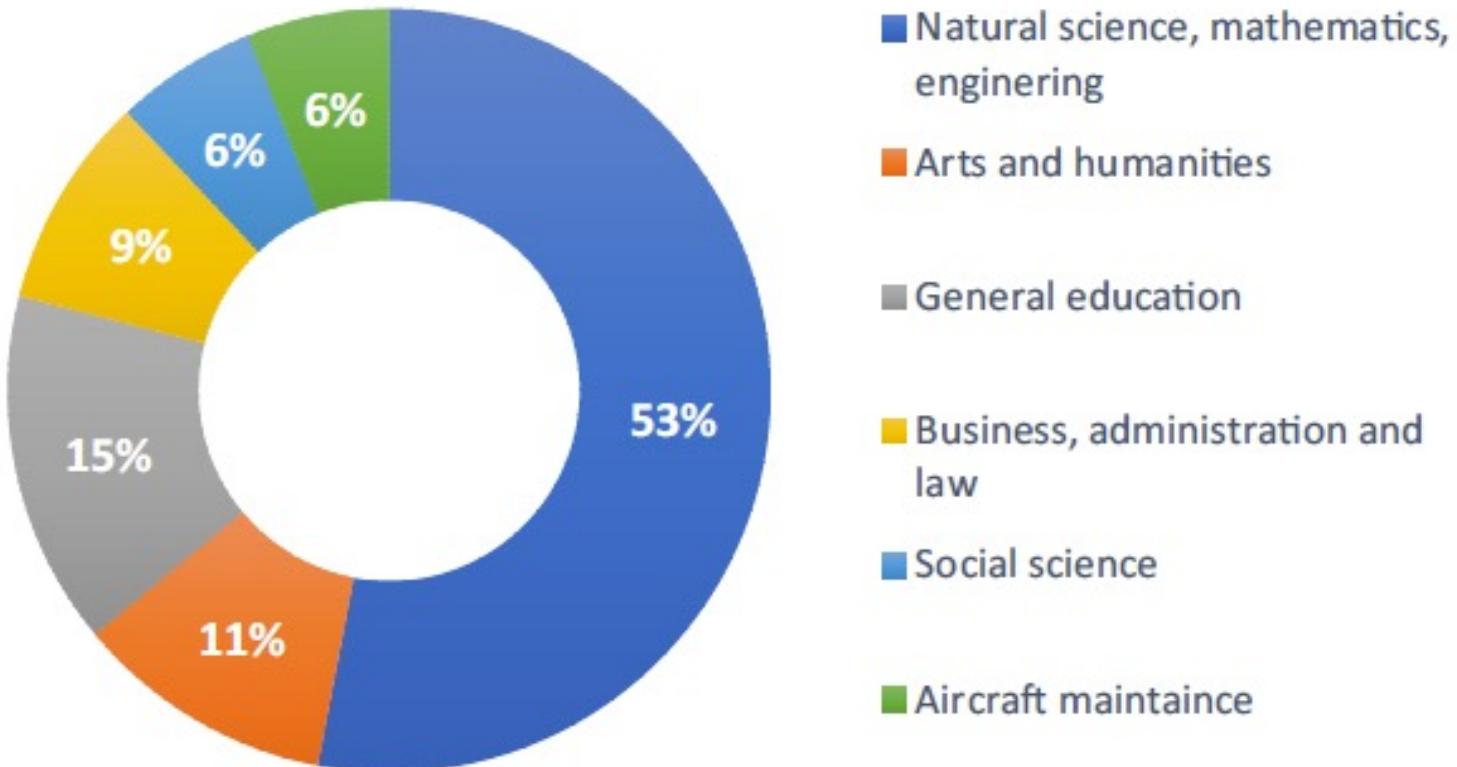


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Overview and Challenges

Distribution of studies by education field

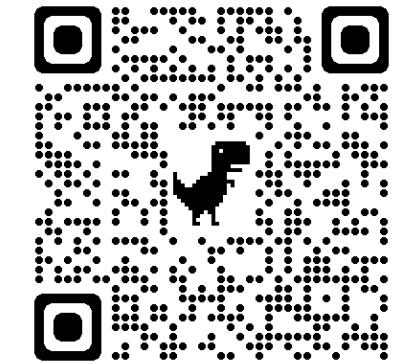
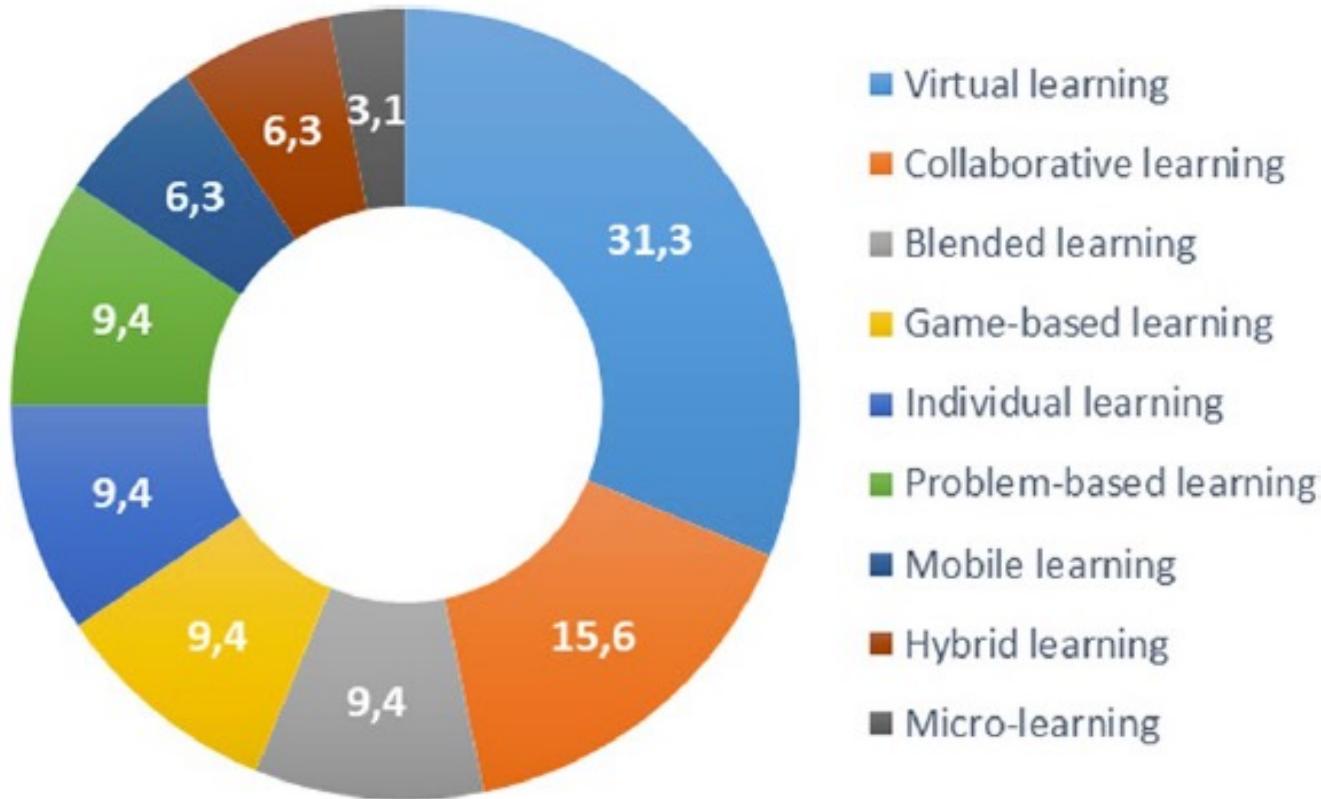


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Overview and Challenges

Implemented learning scenarios in Metaverse in education



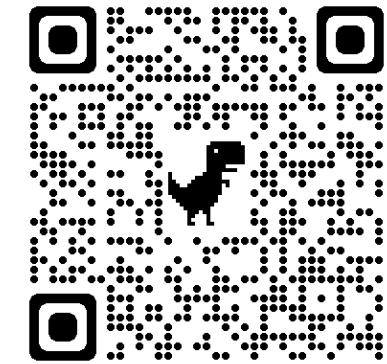
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Overview and Challenges

Associated challenges of Metaverse in education

Category	Challenge	N	%
Technological	Network traffic	6	20,7
	Smartphone interface problem	2	6,9
	Blinks cannot be captured correctly	2	6,9
	Establishment of rules of digital coexistence	1	3,4
	Poor design	1	3,4
Pedagogical	Design the digital resources	4	13,8
	Lack of teacher competencies	2	6,9
	Lack of pedagogical structure	2	6,9
	Inflexibility of applications	2	6,9
	Difficulties with time management for learners	2	6,9
Other	Lack of quantitative analysis	2	6,9
	High design cost	1	3,4
	High practice cost	1	3,4
	Time consuming	1	3,4



Full paper
Scan QR Code

(equal contribution) Ahmed TLILI, Ronghuai HUANG, Boulus SHEHATA, Dejian LIU, Jialu ZHAO, Ahmed Hosny Saleh METWALLY, Huanhuan WANG, Mouna DENDEN, Aras BOZKURT, Lik-Hang LEE, Dogus BEYOGLU, Fahriye ALTINAY, Ramesh C. SHARMA, Zehra ALTINAY, Zhisheng LI, Jiahao LIU, Faizan AHMAD, Ying HU, Soheil SALHA, Mourad ABED, and Daniel BURGOS. Is Metaverse in education a blessing or a curse: A combined content and bibliometric analysis. Smart Learning Environments.

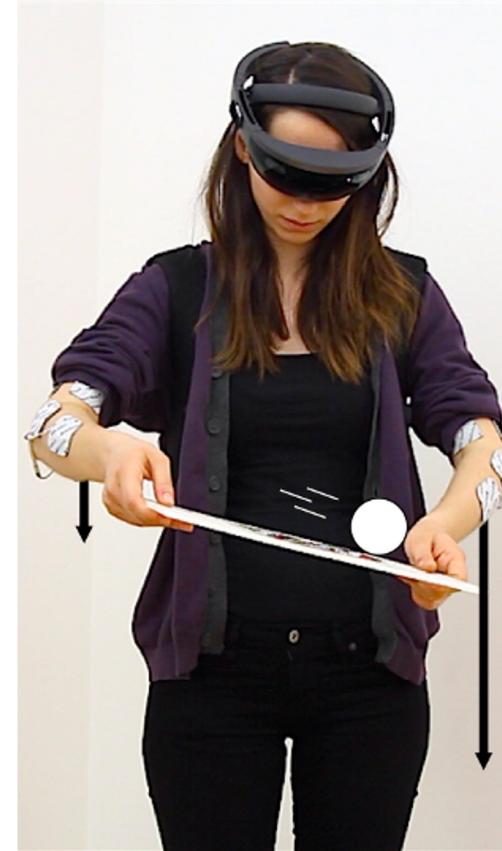
When Education meets the Metaverse...

Challenges

Challenges

Facebook Horizon Workrooms

- **Input:** enabling users to interact with digital entities in physical environments ubiquitously.
- **Visual feedback:** display digital entities to human users.
- Design of multiple user **feedback cues:**
 - audios,
 - haptics,
 - muscle-force feedback, etc.



Challenges

Mobile Input Techniques

Ubii

- An Intergrated interface which allows users to interact with objects in the environment with hand gestures
- Take advantage of hand-gesture recognition and object tracking
- Connect and communicate with smart devices in the environment



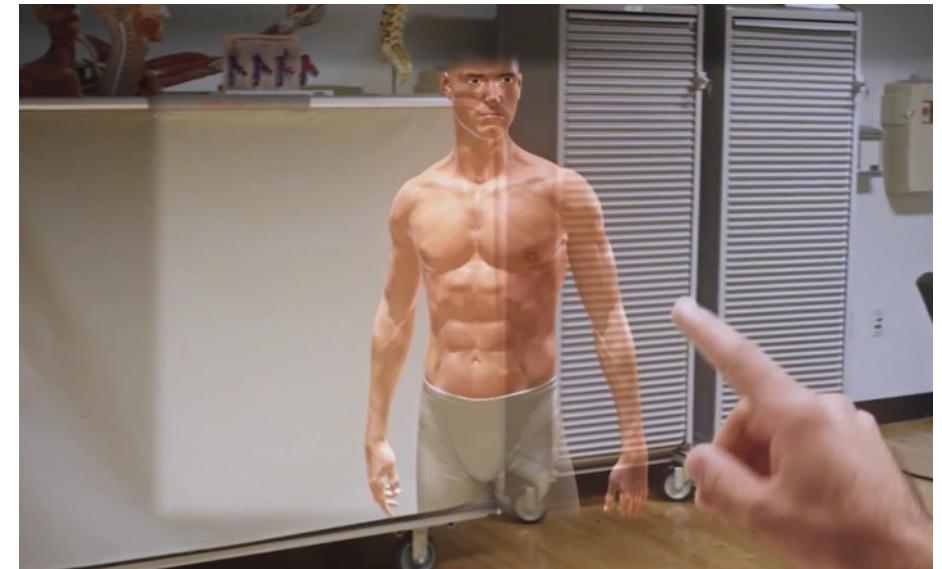
Challenges

Limited Field-of-View (FOV)

Marketing Campaign

What the users actually see

Microsoft
HoloLens 2
Medical Apps^[1-3]



Picture sources:

[1] Microsoft HoloLens Official website.

[2] HoloLens problems show us that AR is still not ready for the mass market: <https://skarredghost.com/2017/02/09/hololens-problems-show-us-that-ar-is-still-not-ready-for-the-mass-market/>

[3] New HoloLens video demos usage in medicine, is more honest about field of view <https://www.windowscentral.com/new-hololens-video-more-honest-about-fov>

Challenges

Limitations

Current Limitations on Hardware:

- Bulky device hinder user experience of immersive metaverse, plus display FOV/quality.
- Limited Function in Natural User Interface (NUI).



Current Limitations on Education Contents:

- Poor graphic quality (pixel art style) due to limited computation power of user device.
- Limited education contents in Metaverse due to lack of content developers.

Challenges

Being (Socially) Presence?



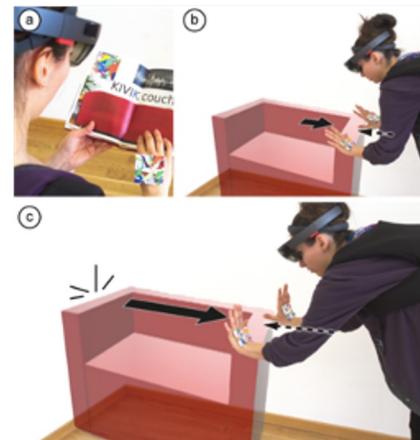
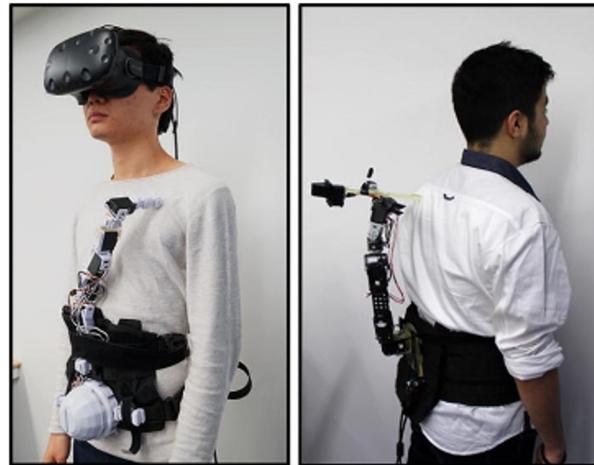
Sit next to each other, everywhere and anytime, on the globe!

Challenges

Being (Socially) Presence?

Feedback

- Digital content becomes "untouchable" in the virtual 3D world.
- Feedback cues are highly correlated with usability and realism in the virtual physical realm.



Sada, M.A., Jiang, K., Ranade, S., Kalkattawi, M., & Nakajima, T. (2019). HapticSnakes: multi-haptic feedback wearable robots for immersive virtual reality. *Virtual Reality*, 24, 191-209.

Lopes et al. 2018. Adding Force Feedback to Mixed Reality Experiences and Games using Electrical Muscle Stimulation. Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, New York, NY, USA, Paper 446, 1–13. DOI:<https://doi.org/10.1145/3173574.3174020>

When Educators meet the Metaverse...

Thank you!

Any Questions?

Access my webpage: www.lhlee.com

